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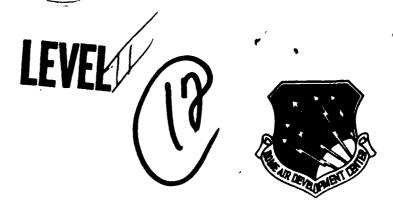UNCLASSIFIED   RADC-TR-81-149   NL

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Final Technical Report
June 1981

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MICROPROCESSOR FRONT-END TERMINAL STUDY

Bunker Ramo

Raymond Arnold
Ward Neely et al

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ROME AIR DEVELOPMENT CENTER
Air Force Systems Command
Griffiss Air Force Base, New York 13441

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The objective of this effort was the definition and description of a modular "intelligent" display terminal for the TACS system which incorporates a programmable microprocessor as a "front-end" to handle communication and teleprocessing interfaces and protocols. The unit should be able to function as a stand alone terminal, as a terminal to a processing facility or as an independent mode on a network of data processing systems. The main emphasis of the system analysis was JINTACCS messages at the
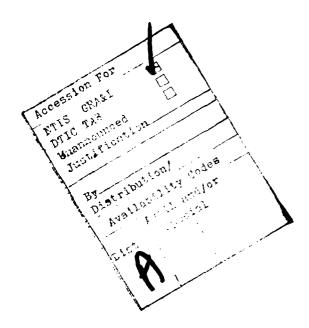
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1. INTRODUCTION

1.1 <u>Purpose.</u> The purposes of this project are to describe the requirements for a computer system at various components of the Tactical Air Control System (TACS) and to recommend data processing equipment that could be procured to further investigate these requirements. The equipment shall include a programmable microprocessor as a "front end" to handle communication interfaces and protocols. For this reason, the equipment shall be called the Microprocessor Frontend Terminal (MFT). The equipment shall also provide a general data processing capability and shall be able to operate in any of the following modes:

(a) As a communication front end to another computer
(b) As an intelligent terminal to another computer
(c) As a stand-alone data processing system
(d) As an independent node in a network of data processing systems.

1.2 <u>Approach.</u> The work was divided into two concurrent efforts to pursue the dual purposes of the project. The results of those efforts were brought together to produce the desired equipment recommendation. The two efforts were as follows:

1.2.1 TACS facilities survey. The military units that comprise the TACS were identified, and their organizations, duties, and responsibilities were examined. These units are the environment in which the MFT must operate. They are described in Paragraph 2. The detailed functional requirements that are placed upon the MFT by various TACS components are described in Paragraph 4. The reference documents that provided the necessary information are listed in Appendix A.

1.2.2 Equipment survey. The microprocessor-based data processing equipment now available on the commercial market was investigated. Its technical capabilities were assessed and compared with the functional requirements as they emerged from the facilities survey. The progress of the equipment survey is described in Paragraph 3. A summary of the hardware characteristics implied by the functional requirements is given in Paragraph 4, and the recommended configuration is described in Paragraph 5.

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1.3 <u>Summary.</u> The aerial functions of the Tactical Air Force (TAF) are supported by a well defined group of command and control tasks that can be effectively supported by a network of data processing systems. These tasks are characterized chiefly by the information that they handle and are virtually independent of the specific mission and organization of the TAF. Much of this independence is due to the efforts of the Joint Interoperability of Tactical Command and Control Systems (JINTACCS) organization. The information formatting standards developed by this group make it possible for the TAF to communicate directly with units of any other armed service of this country or any friendly nation. The information necessary to conduct almost any type of aerial mission has been specified, and a data processing system can be designed to respond to any or all of this information.

Coupled with the JINTACCS standards are the standards for data transmission protocols established by the worldwide AUTODIN network. Even if the MFT is not actually communicating with members of the AUTODIN network, it can utilize the same transmission standards within a local TACS network. The basis for the design of an MFT information control program is presented in Appendixes B through E.

The data processing services necessary to support the TACS command and control tasks can be provided by microprocessor-based equipment that is now available for off-the-shelf delivery from a single vendor. No such equipment is now in use by the TAF, but equivalent configurations have been extensively tested in commercial and industrial applications. There is no need to develop new equipment items to satisfy TAF needs, and, in fact, there is no need to experiment initially with hardware that has not been proven in other applications. System development and experimentation can be confined to the applications programs that must be created to support the TACS command and control tasks. An equipment configuration will be recommended for the MFT that utilizes up to five microprocessors to apply all of the advantages of integrated circuit technology to the requirements of the TACS.

2. MFT ENVIRONMENT

2.1 Tactical Air Force. The Tactical Air Force (TAF) is an organization of specialized Air Force units that is created to undertake a specific combat mission. The organization may be as large as a numbered air force (such as the 9th U.S. Air Force), or it may contain only a few of the units from a numbered air force. Regardless of its size, the TAF has a single commander, the COMTAF, who is responsible for every aspect of its operations. The TAF usually serves as a component of a Joint Task Force (JTF) that includes elements from U.S. or allied nations' naval and ground forces. A single JTF commander provides broad joint-service, multi-service tactical guidance and mission role assignments. He may, in turn, be responsible to a Theater Commander, to the U.S. Joint Chiefs of Staff, or to some multi-national organization.

The combat functions, the organization, and the communications of the TAF are described briefly in the following paragraphs. The intent is to identify the staff operations that could be supported by a network of data processing equipment. More complete information is available in the three documents that served as references. These are:

(a) "TACR 55-45, Tactical Air Force Headquarters and the Tactical Air Control Center", Draft, January 1980.
(b) "TAC CONPLAN 61 - TAC Standard Communications Plan", January 1980 (FOUO).
(c) "Tactical Air Forces Integrated Information System (TAFIIS) Master Plan, September 1980 (SECRET)

2.1.1 TAF combat functions. All of the major combat functions that may be conducted within the TAF are described here. The exact nature and extent of the functions of any TAF depend upon the geographic and political situations, the type of operation, the presence of other friendly forces, and upon natural factors such as weather and terrain. The first requirements for data processing equipment such as the MFT are clear. The equipment must be air transportable, and its exact functions must be readily adaptable to a wide variety of operations. These and other requirements are discussed in Paragraph 4.

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2.1.1.1 Counter air operations. The purpose of counter air operations is to destroy or neutralize the enemy's aerial offensive and defensive systems. Offensive counter air activities are conducted to destroy enemy aircraft in the air and also to disable ground facilities and weapons before they can be used to attack. Defensive counter air activities are employed to defend against aerial attack upon friendly forces. Counter air operations are provided by specially trained and equipped squadrons that are assigned as necessary to the TAF.

2.1.1.2 Offensive air support. Offensive air support operations assist friendly ground forces and usually attack enemy ground forces and installations. Close air support is a term that refers to action against enemy forces close to and in engagement with friendly forces. Battlefield air interdiction describes action against enemy forces that threaten but are not yet engaged with friendly units. If the TAF mission requires offensive air support, one or more specialized squadrons will be included in the organization.

2.1.1.3 Air interdiction. Air interdiction refers to tactical air operations that are directed against the enemy's rear area to neutralize military capabilities before they can be used against friendly forces. Air interdiction targets include transportation systems, concentration points, communications facilities, stockpiled supplies, and industrial installations. These operations differ from other offensive actions against ground targets because of the range and size of the aircraft and the types of weapons that are delivered. One or more squadrons may be included in the TAF to provide air interdiction.

2.1.1.4 Tactical air reconnaissance. This function employs airborne collection devices to gain knowledge of the enemy and his environment. It comprises not only the collection of data but also the processing and interpreting of that data and the distribution of the resulting intelligence. Its products are printed reports, data displays, magnetic tapes, and photographic imagery. Specially trained and equipped squadrons are available to provide reconnaissance for the TAF. Their equipment and functions will be adjusted to the type of mission. Reconnaissance units now use specialized data processing systems of different kinds and probably would be principal users of any new tactical equipment such as the MFT.

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2.1.1.5 Tactical air lift. This function provides air movement of combat troops and supplies throughout the theater of operations and particularly to the combat zones. It includes aeromedical evacuation, flare drops, and leaflet drops. Tactical airlift facilities can also be used to augment the strategic air lift system that brings troops and supplies to the theater of operations. This function is also provided by specially equipped and trained squadrons that are assigned to the TAF only as needed.

2.1.1.6 Air combat support. Functions in this category include electronic warfare, combat search and rescue, and air refueling. Electronic warfare refers to the detection and neutralization of enemy electronic devices such as radio and radar. Combat search and rescue recovers personnel and equipment from crashed aircraft. Air refueling operations use specially equipped tanker aircraft to extend the flying range of tactical fighter and reconnaissance aircraft. Each of the combat support functions requires special equipment and specially trained units that are assigned to the TAF as necessary.

2.1.1.7 Airspace management. This function coordinates, integrates, and regulates the flow of aerial traffic throughout the entire area of a tactical operation. It also coordinates friendly ground-based air defense system activities with aerial traffic.

2.1.1.8 Air traffic regulation. This function implements the policies of the airspace management function. It uses radar surveillance and control, electronic flight monitoring data, and periodic position reports to promote safe and rapid movement of aircraft throughout the TAF operational area.

2.1.1.9 Special operations. This function includes support activities such as counterinsurgency, unconventional and psychological warfare, and military civic actions. The size, composition, and equipment of a force devoted to any of these special functions are dependent upon the nature of the mission.

2.1.2 TAF organization. The TAF has a single commander who directs the activities of all subordinate units that may be provided to accomplish his mission. The TAF commander (COMTAF) establishes a centrally located headquarters and depends upon electronic communication for contact with his combat forces. He is directly supported and advised by a staff of specialists who receive reports from and transmit orders to the remotely located combat units. The number and the functions of the combat units may vary with the mission, but the duties of the headquarters staff remain relatively constant.

Each subordinate unit also has a commander and a headquarters staff to carry out his orders. The staff elements at all the various echelons hold the TAF together using several systems of communication. They would be the users of a tactical data processing system. To specify such a system, it is necessary to understand not only the functions of headquarters staff elements but also the characteristics of the tactical communication facilities.

2.1.2.1 TAF Headquarters. The TAF Headquarters (TAFHq) consists of command and staff elements that plan and direct the employment of tactical air resources. Through the TAFHq, the COMTAF apportions his resources among the combat functions that were previously described. The standard staff elements of the TAFHq are shown in Figure 1. Combat operations are directed by the Deputies for Operations, Intelligence, Logistics, and Communications. Their duties are described briefly in the following paragraphs with emphasis upon those duties that could be assisted by a data processing system. The remaining staff elements shown in Figure 1 provide non-combat support and will be not be discussed here.

(a) Deputy for Operations (DO). The DO and his staff plan and direct air combat operations. They exercise operational control over subordinate units, make recommendations for force apportionment, and establish requirements for intelligence collection.

(b) Deputy for Intelligence (IN). The IN and his staff are responsible for intelligence support to the TAFHq and all subordinate units. They provide overall guidance and technical direction to intelligence elements within the TAF. They also provide the management interface with theater and national intelligence systems.

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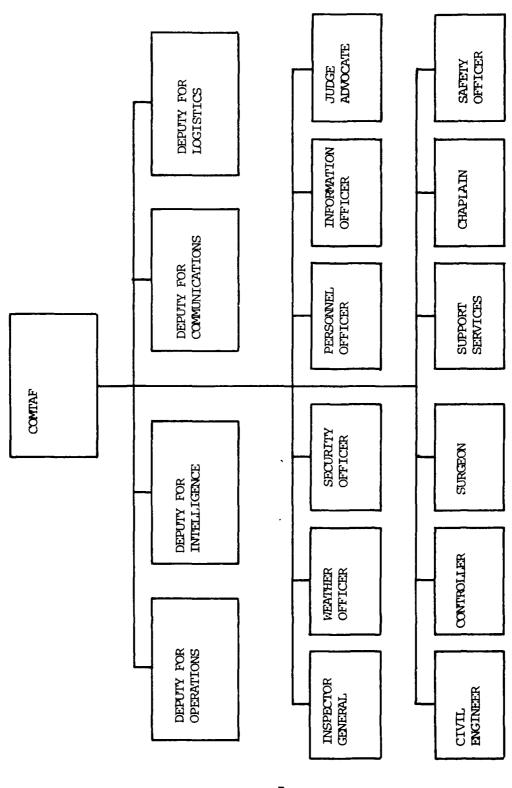
Figure 1: Tactical Air Force Headquarters Organization

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(c)   Deputy for Communications (DC). The DC and his staff
      plan and direct the installation and operation of Air
      Force communications and electronic facilities for
      the entire TAF. They coordinate with other U.S. and
      allied military and civilian authorities to affect
      optimum use of all available facilities.

(d)   Deputy for Logistics (LG). The LG and his staff
      supervise subordinate elements that provide
      expendable supplies such as food, fuel, armament, and
      spare parts. They direct logistical planning,
      supply, maintenance, transportation, and
      procurement.

2.1.2.2   Tactical Air Control System (TACS). The TACS is
the network of military organizations and communications
necessary to plan, direct, and control tactical air operations
and to coordinate air operations with other armed services and
nations. A schematic diagram of the organizations and internal
and external communication channels that comprise a typical TACS
appears in Figure 2. The central point of the TACS is located
at the TAFHq and more specifically at the Tactical Air Control
Center (TACC). The air combat units are at the Wing Operations
Centers (WOCs) shown in Figure 2. The TACC and the WOC are the
most important elements of the TACS and are described completely
in Paragraphs 2.2 and 2.3. The communication facilities that
bind together the elements of the TACS are described in
Paragraph 2.1.3. All of the organizations that may be included
in the TACS are described briefly in the remainder of this
paragraph.

2.1.2.3   Tactical Air Control Center (TACC). The TACC is
the operations center for the COMTAF. It is manned by staff
elements reporting to the Deputies for Operations and
Intelligence. The TACC plans, directs, and monitors the
execution of all the previously described TAF combat functions.
The TACC receives, evaluates, displays, stores, and distributes
a great deal of data. It therefore has an urgent need for the
benefits of an integrated data processing system. The proposed
MFT could provide many, but not all, of the data processing
services needed at the TACC.
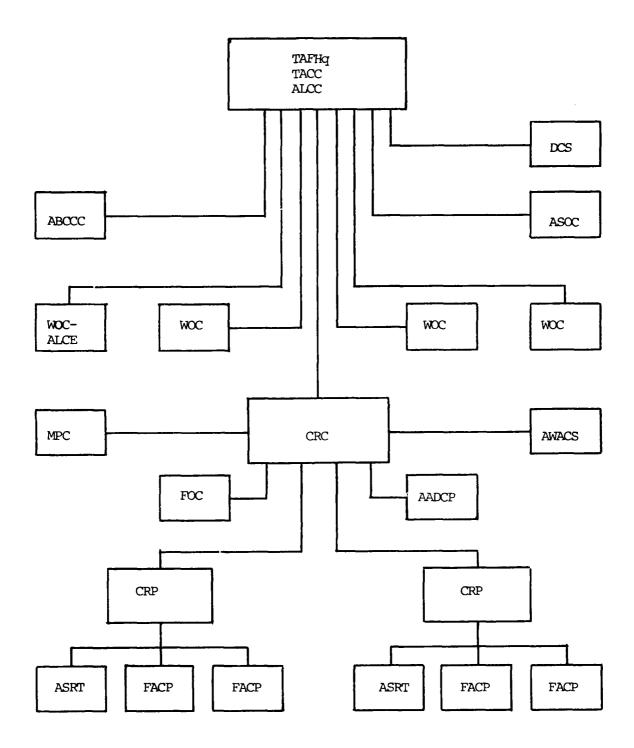
Figure 2: Components of a Typical TACS

2.1.2.4 Wing Operations Center (WOC). The wing is the principal tactical air unit, and the WOC is the facility from which the wing commander directs his resources. These resources consist primarily of flying squadrons which perform the TAF combat functions such as fighter support, reconnaissance, and airlift. The WOC possesses communication links to all assigned and attached units as well as to the TACC. When deployed, the WOC is established at a temporary location called the Tactical Air Base (TAB). Some, but not all, subordinate units will also be located at the TAB. A single TAF may include from one to nine WOCs. The WOC exchanges a large amount of data with many other components of the TACS. It has a need to select, evaluate, store, and recall this data, and it therefore also requires a data processing system. A key requirement of such a system is that it must be capable of communicating directly with other similar systems by using presently available tactical communications facilities. The proposed MFT shall be capable of meeting all of the data processing needs of any WOC.

2.1.2.5 Control and Reporting Center (CRC). The CRC directs the air defense, airspace control, and mission monitoring functions for the TAF under the general supervision of the TACC. It supervises radar elements, scrambles air defense aircraft, and coordinates with ground based anti-aircraft defense systems. It also coordinates airspace usage with allied forces and other components of the JTF. Figure 2 shows connections from the CRC to the Army Air Defense Command Post (AADCP) and the Navy Fleet Operations Center (FOC). The CRC includes an Air Traffic Regulation Center, and it may be designated by COMTAF to serve as an alternate TACC. Figure 2 shows that much of the message traffic between the TACC and the more widely dispersed subordinate units must be relayed through the CRC. An MFT must be placed at the CRC to support local operations and to communicate data to the TACC and the WOCs. The CRC, in particular, illustrates the requirement for an MFT to be able to function as a store-and-forward switching center as well as to function as a terminal in the network.

2.1.2.6 Control and Reporting Post (CRP). A CRP is subordinate to the CRC. It provides radar surveillance and control within a subsector of the TAF area of responsibility. More than one CRP may be employed, depending upon the area size, terrain features, and the anticipated level of air operations. A CRP has capabilities similar to those of a CRC, and it may assume the functions of a CRC when directed by the TACC. The CRP must have an MFT to provide data communication with other TACS elements and to perform local data processing services. The MFT at the CRP may not need a full range of data processing capabilities, but it will have an important store-and-forward function. The CRP thus illustrates a general requirement for the MFT to be capable of being adapted in the field to the needs of the using organization.

2.1.2.7 Air Support Operations Center (ASOC). This unit coordinates air support operations with ground forces, and it is usually colocated with an Army Corps Tactical Operations Center. The ASOC accepts requests for close air support and reconnaissance, scrambles allocated missions, and directs both immediate and preplanned missions through its subordinate Tactical Air Control Parties (TACPs). The ASOC possesses personnel with a variety of combat skills and is thus a good choice to serve as an alternate TACC. The ASOC must therefore have an MFT and must be capable of receiving and storing the data that would enable it to perform as the TACC. The ASOC MFT must be adaptable in the field to new functions, and it must provide a store-and-forward capability. Eventually, the MFT must be capable of being programmed to exchange data with other data processing systems used by other armed services and nations. This is not expected to be a difficult requirement for the MFT because widespread efforts are now under way to standardize data formats and communication protocols.

2.1.2.8 Air Lift Control Center (ALCC). The ALCC has overall responsibility for directing airlift operations to support the TAF. It reports to the COMTAF and is colocated with TAFHq and the TACC. Because of the size of the headquarters area, the ALCC needs electronic data communications with the TACC as well as with other elements of the TACS. The ALCC also manages strategic airlift missions which enter the TAF's geographic area. For this purpose, the ALCC reports directly to the Commander-in-Chief, Military Air Lift Command, through the Defense Communications System.

2.1.2.9 Air Lift Control Element (ALCE). An ALCE is established at each airfield and landing zone to provide operational control of airlift aircraft. All ALCEs are subordinate to the ALCC but are colocated with the WOCs that utilize airlift aircraft. Because of their relatively small volume of data and their proximity to the WOCs, the ALCEs probably will not need MFTs.

2.1.2.10 Airborne Battlefield Command and Control Center (ABCCC). The ABCCC is an airborne extension of the Combat Operations Division of the TACC (see Paragraph 2.2.3). It is carried by a specially modified aircraft that contains extensive facilities for voice and radio teletype communication. The ABCCC can maintain contact with mission aircraft for long distances and over terrain that would block ground-based communications. It can be used as an airborne ASOC or as a relay station for the TACC. Although the ABCCC sends and receives data messages needed by many components of the TACS, it is not a candidate for installation of an MFT because it does not use the requisite communication facilities. It will be shown below that any MFT could communicate with the ABCCC by relaying through a unit such as the Message Processing Center (Paragraph 2.1.2.12) that would operate both an MFT and a radio teletype station. A requirement may be established for an MFT to be capable of both producing and accepting punched paper tapes in some functional configurations to communicate with teletype equipment.

2.1.2.11 Airborne Warning and Control System (AWACS). This is an aircraft equipped with extensive radar and communications equipment. It performs surveillance, warning, and control functions and also provides information for battle management. An AWACS is normally subordinate to the CRC, and it performs as a CRP. During the initial stages of a TAF deployment, the AWACS may perform the functions of a CRC or even some of the functions of the TACC. It is not proposed to install an MFT in an AWACS. A ground based MFT may relay data to and from an AWACS through radio teletype at a unit such as the Message Processing Center.

2.1.2.12 Message Processing Center (MPC). The MPC manages digital data links that transfer radar track information from computers at the CRC and the CRPs to the AWACs and to similar command and control systems operated by other armed services. Figure 2 shows that the TACS often can include terminals in the Navy Fleet Operations Center (FOC) and at the Army Air Defense Command Post (AADCP). The MPC also prepares and distributes prearranged technical and tactical data prior to a tactical situation. The MPC requires an MFT both to handle relay traffic for airborne elements and also to distribute background data to other components of the TACS.

2.1.2.13 Forward Air Control Post (FACP). This is a mobile radar element that is deployed into forward areas to extend radar coverage, to provide early warning of attack, and to control air operations. It is subordinate to the CRC or to a CRP. The TACS may include several FACPs if they are required by the tactical situation. It is not proposed at present to provide an MFT for any FACP because of the low volume of data traffic that is anticipated. This traffic can be handled by radio teletype.

2.1.2.14 Air Support Radar Team (ASRT). This is a highly mobile element equipped with precision, beacon-tracking radar. It provides all-weather, ground-directed bombing guidance and also provides all-weather navigation assistance for reconnaissance and airlift aircraft. The ASRT is normally controlled by the TACC. Several ASRTs may be included in the TACS, if required. It does not appear to be necessary to equip an ASRT with an MFT.

2.1.2.15 Tactical Air Control Party (TACP). TACPs are forward operating mobile facilities that deploy with Army echelons from corps down to battalion. As a forward extension of the ASOC, they assist ground force commanders in planning, requesting, coordinating and controlling tactical air support missions. The TACP provides the functional interface between the Army unit to which it is attached and the air units providing tactical air support.

2.1.3 TAF communications. The TAF uses three different electrical communication systems depending upon the tactical situation and the duties of the communicating units. In many situations, all three systems will operate concurrently. Most communication is conducted by voice transmission, but teletype and digital data signals are also used. Any proposed data processing network for the TAF will be required to share available tactical communication facilities with existing services.

The equipment now in use is collectively designated as the 407-L system. Modernized equipment is being developed under the TRI-TAC program, but no substantial deliveries to the field are expected for several years. The existing equipment imposes certain technical restrictions upon data processing devices. These restrictions are discussed in Paragraph 5.1. The TRI-TAC equipment may alter the interface requirements to a certain extent, but it seems unlikely that outright imcompatibility with existing equipment would be created. The three present communication systems are described briefly in the following paragraphs. Technical descriptions of the equipment and explanations of the communications terminology may be obtained from AFM 11-1, Vol. III, "Administrative Practices, Communications Electronics Terminology".

2.1.3.1 TACS wideband communication system. This system provides the principal means of telephone communication between geographically separated units on the ground. It is also the system that would be used to support a data processing network. It uses radio equipment that is bulky, expensive, and difficult to install. For these reasons, the wideband communication system is not available during the initial hours of a tactical operation, and it is not provided to the smaller and more mobile units. The MFT is required to provide a stand-alone data processing capability to afford access to previously stored data during the crucial period immediately following deployment.

A typical arrangement of this system is shown in Figure 3. Each interconnecting line represents 24 telephone trunks. Many of the trunks are designated "sole user channels" and are assigned permanently to important services that require unrestricted communication. The remaining trunks are shared through a telephone switchboard by all other users. Local telephones within the headquarters area are connected to the switchboard with temporary wire circuits. The distance between two sets of wideband radio equipment cannot exceed approximately 75 nautical miles depending upon terrain, so that it is frequently necessary for a caller to arrange a connection through two or more manual or automatic switchboards. A sole user channel can be permanently connected through a switchboard. With additional equipment, it is also possible for as many as four teletype circuits to simultaneously use a single sole user channel. The wideband system can communicate with similar tactical telephone systems used by other armed services and nations. It can also be connected into the Defense Communication System and can provide both voice and data communication from the TAF to any of the users of that system.

2.1.3.2 High frequency independent side band (HF/ISB) radio net. This system utilizes smaller, readily relocatable radio equipment to provide point-to-point communications between tactically deployed units. It affords only one voice channel between any two communicating units, and this channel must be shared by all users. A typical TACS HF/ISB system is illustrated in Figure 4. It is the first service to be established during a tactical movement and the last to be deactivated. It backs up the wideband system after that service has been established, and it serves locations that are outside the range of the wideband system. Mobile HF/ISB radio stations may be used as terminals in the Defense Communication System AUTOVON and AUTODIN networks. AN HF/ISB net may be used for teletype communication, and a "torn tape" manual relay facility is often established at the TAFHq and the TACC. If there is a requirement for a data processing system to communicate with the teletype system, a manual interconnection procedure would probably be established at the torn tape facility.
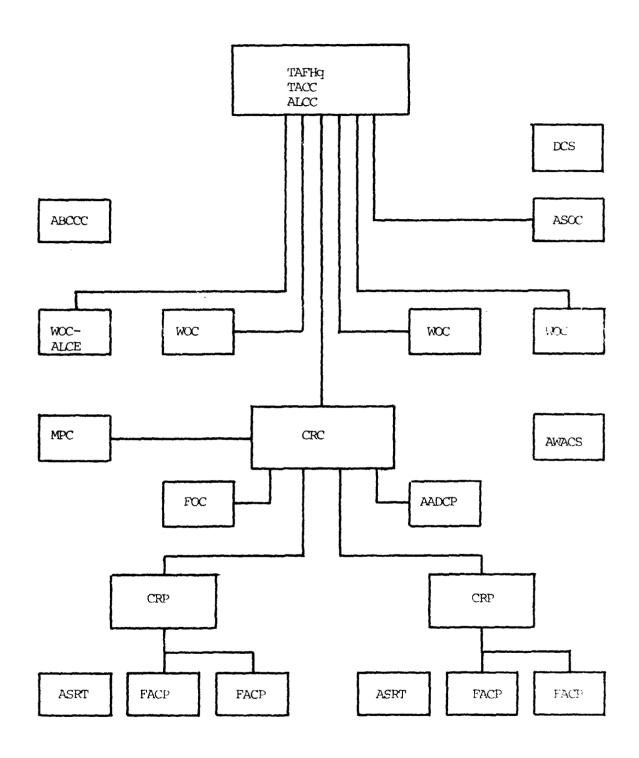
Figure 3: Typical TACS Wideband Communication System

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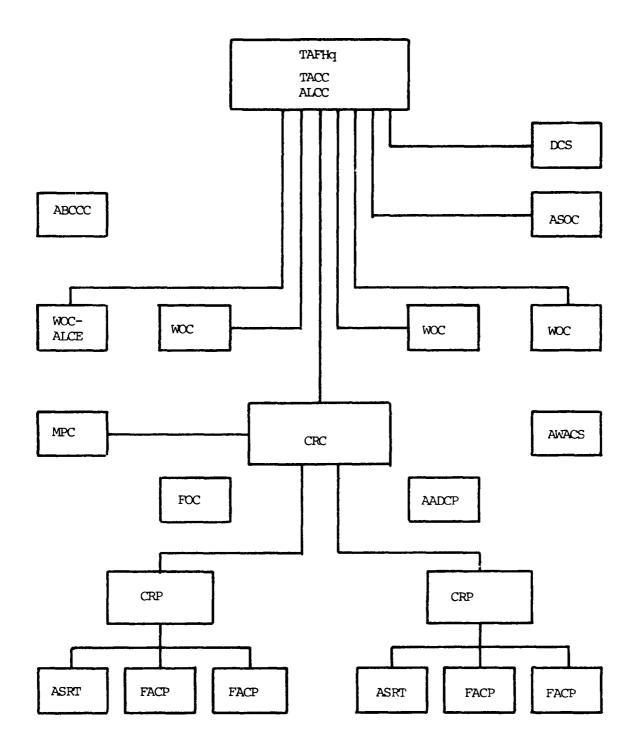
Figure 4: Typical TACS HF/ISB Communication System

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2.1.3.3 High frequency single sideband (HF/SSB) radio nets. Approximately 18 different communication networks using HF/SSB radios are routinely established within the TACS to provide communication to units not served by the wide-band or HF/ISB systems. These networks are used to communicate between ground stations and aircraft in flight. In particular, several different HF/SSB networks provide voice, teletype, and digital data links between the TACC and its airborne counterparts in the AWACS and ABCCC aircraft. The digital data links are part of the two TACS Automatic Data Links known as TADIL A and TADIL B. These transfer radar track information and are not available for transmitting the conventional operations and intelligence messages that would be handled by an MFT.

2.2 TACC organization. The TACC has been described previously as the COMTAF's operations center and the heart of the Tactical Air Control System. It is served by all of the TAF communication systems, and it would be the central component of any proposed data processing network. The TACC is manned by staff elements that report to the Deputies for Operations and Intelligence as shown in Figure 5. The Operations staff and the Intelligence staff both have planning functions as well as execution functions, and both are separated into two divisions. The Director of Combat Operations is the senior officer and is the supervisor of the TACC. The organizations of the four divisions are described in the following paragraphs. The functions of the TACC are each executed in part by different organizations of the TACC and in part by other components of the TACS. For this reason, the tasks of the TACS as a whole are described together in Paragraph 2.4.

2.2.1 Combat Plans Division. This division plans the day-to-day expenditure of air resources and the corresponding airspace management procedures. Plans are based upon the TAF objectives outlined by the Deputy for Operations in the daily Air Operations Order. The plans are also based upon a large amount of data that describes all aspects of the current situations of both friendly and enemy forces. It will be shown later that the requisite data is provided in various ways by other TACC divisions and by many subordinate organizations. The major product of the Combat Plans Division is the Air Tasking Order which contains the detailed plans for all units and which is distributed throughout the TACS.
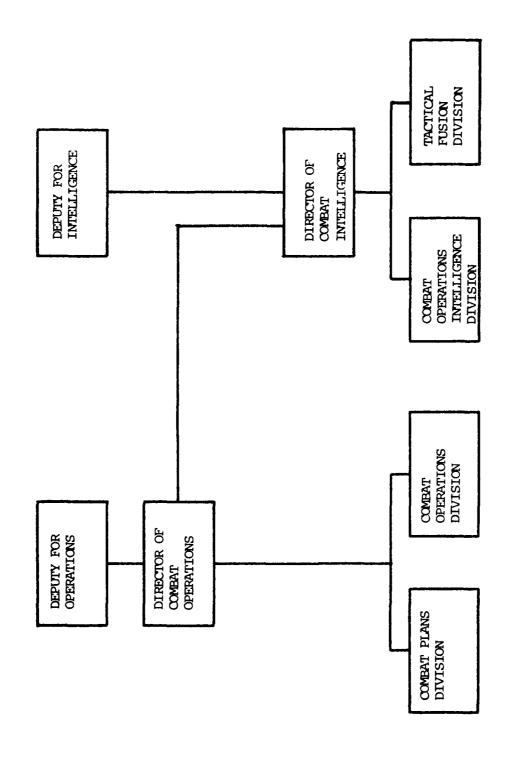
Figure 5: Tactical Air Control Center Organization

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2.2.1.1 Organization. The Combat Plans Division is composed of branches whose duties correspond generally to the TAF combat functions that have been previously described. A typical organization is shown in Figure 6. The exact composition of the division at any time depends upon the combat functions required to carry out the specific mission.

(a) Fighter Planning Branch. This branch is composed of fighter officers who plan the employment of tactical fighter aircraft in counter air, interdiction, and offensive air support functions.

(b) Reconnaissance Planning Branch. This branch is composed of reconnaissance officers who plan the employment of reconnaissance aircraft.

(c) Specialized Support Planning Branch. This branch plans aerial refueling, forward air control, search and rescue, AWACS and ABCCC utilization, and airspace management.

(d) Command, Control, and Communications Countermeasures (C3CM) Combat Support Branch. This branch plans electronic warfare, suppression of enemy air defense, and communications countermeasures.

(e) Special Operations Branch. This branch plans unconventional warfare and psychological warfare operations.

(f) Air Lift Planning Branch. This branch plans airlift operations, but only if an ALCC is not assigned to the TAF.

(g) Component Services Liaison Branch. This branch is composed of liaison officers from other armed services and nations that are participating with the TAF in a joint operation.

(h) Operational Status Branch. This branch provides the administrative services necessary to receive, record, and post data and to maintain a log.

2.2.1.2 Duties. Each branch is manned by officers who are trained and experienced in the combat functions assigned to that branch. These officers all have similar duties that can be summarized as follows:
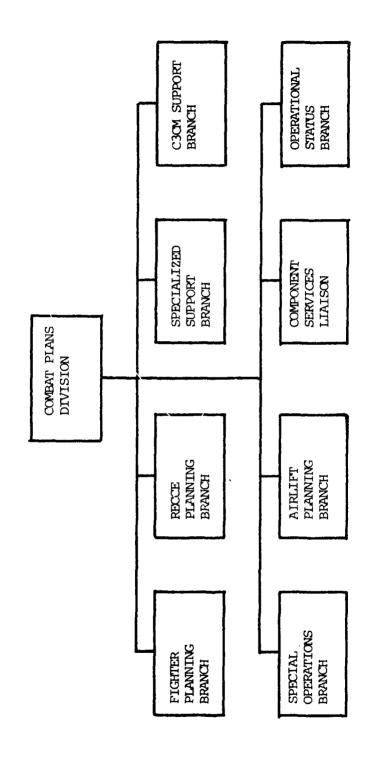
Figure 6: TACC Combat Plans Division Organization

(a) Monitor the status of their resources. The resources are the flying and support units that have been described as components of the TACS. Status information is actually obtained and displayed by other TACC elements. The necessary information describes the availability and locations of aircraft, aircrews, airfields, munitions and fuel.

(b) Monitor the combat situation. The situation includes the identities, locations, activities, and capabilities of all friendly and enemy units in the area of interest. It includes the provisions and results of the last Air Tasking Order and the current directions from the COMTAF. It also includes the nature of the terrain and weather in the geographic area of interest. This information is collected and presented graphically and verbally by other TACC elements.

(c) Review requests for missions. Depending upon the type of combat function involved, these requests are either inherent in the Air Operations Order or are received over communication channels from other components of the TACS or the Joint Task Force. Requests are evaluated for completeness, appropriateness, and urgency. Requests may be rejected, combined or tentatively approved.

(d) Recommend commitment of resources. Recommendations are based upon consideration of all available data and upon the application of personal experience and judgment. Recommendations are subject to review by superiors and to coordination with other TAF missions. Approved missions are described in the Air Tasking Order by identifying the flying units, the number and type of aircraft, the special equipment or armament, the general route, and the times of take-off, arrival on target, and return.

(e) Maintain a daily events log. All correspondence and verbal agreements relative to commitment of resources are kept for reference by supervision and by personnel of other shifts.

2.2.2 Combat Operations Intelligence Division. This division is colocated with the Combat Plans Division in the TACC. It provides the detailed information to support the planning process that culminates in the Air Tasking Order. The division has four branches, as shown in Figure 7. Their duties are the following:

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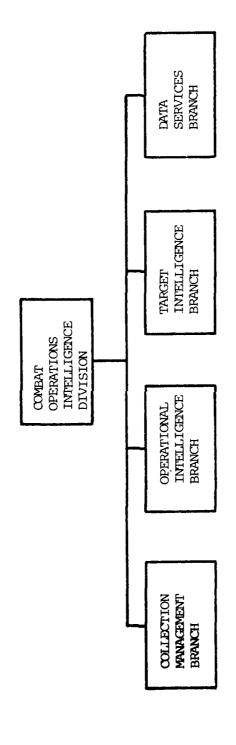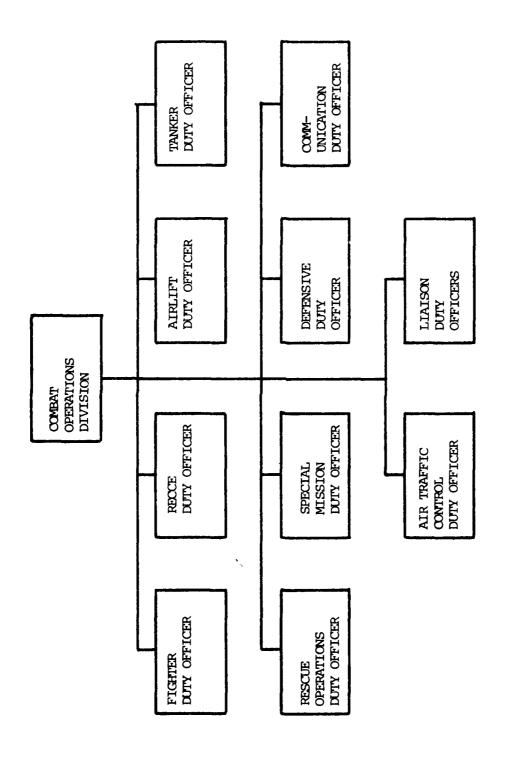
Figure 7: TACC Combat Operations Intelligence Division Organization

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2.2.2.1 Collection Management Branch. This branch works closely with the Reconnaissance Planning Branch of the Combat Plans Division. Both branches are staffed by reconnaissance officers, and together they have the following duties:

(a) Monitor the status of their resources. These resources are the flying squadrons that are specially equipped to collect information from the air. The branch also knows the availabilities and capabilities of data collection resources not directly subordinate to the TAF.

(b) Review requests for intelligence collection. These requests may be preplanned requests based upon the provisions of the Air Operations Order, or they may be immediate requests received from other elements of the TACC, the TACS, or the JTF. Requests are evaluated for completeness, appropriateness, and urgency. Requests may be rejected, combined, satisfied from the results of previous collection efforts, or tentatively approved.

(c) Prepare collection plan. The plan provides for the satisfaction of as many requests as possible with the available collection resources. It identifies the flying units, the sensors to be used, and the times at which sorties should take off, appear over target, and return. The collection plan is coordinated with other proposed TAF missions and is incorporated into the Air Tasking Order.

(d) Monitor collection results. The status of each collection mission is continually displayed. The collected data is reviewed, analyzed, and sent to requestors. Unfulfilled requests are retained for future action, and the status of all requests is displayed at the TACC and reported to requestors.

2.2.2.2 Operational Intelligence Branch. This branch evaluates all available information to determine enemy capabilities and vulnerabilities. It has the following duties:

(a) Maintain Enemy Order of Battle files. These files describe enemy air, ground, and naval units, installations, and weapons systems capabilities that are a direct or indirect threat to friendly forces or that support a threat to friendly forces. The files are maintained by this branch acting independently or in coordination with lateral services or national agencies.

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(b) Maintain Battle Situation files. These files depict specified lines of demarcation in the immediate battle area. The lines of demarcation are coordinated with friendly ground forces. They include the FEBA (forward edge of the battle area), the FLOT (forward line of own troops), and the FSCL (fire support coordination line).

(c) Maintain the Current Situation Map. This map is provided for the use of all TACC personnel. It shows key items from the order of battle files including locations and identities of friendly and enemy units and installations. The map also shows the usual lines of demarcation.

(d) Monitor incoming intelligence. All incoming reports are evaluated, and their contents are used to update the order of battle files and the current situation map. Significant events and potential threats are reported verbally to other TACC elements as appropriate.

(e) Prepare routine intelligence reports. These reports contain standardized summaries of current intelligence. They are distributed at regular intervals to higher, lateral, and lower units. Among these reports are the INTSUM, DISUM, INTREP, and OB Report.

(f) Recommend additional intelligence collection. This branch is in the best position to detect gaps in the intelligence data base and to recommend special collection to the Collection Management Branch.

2.2.2.3 Target Intelligence Branch. This branch examines the current combat situation and selects enemy forces and installations as potential targets for air attack. Its duties are as follows:

(a) Monitor incoming intelligence. Identify potential targets.

(b) Weaponeer all potential targets. Weapons appropriate to the target are selected from the air resources available to the TAF.

(c) Nominate targets. Targets are recommended for the Fighter Planning Branch to nominate for counter air and air interdiction operations. Assistance is given in describing approved targets and sorties for the Air Tasking Order.

(d) Maintain the Installation Data Base. This is a file describing enemy installations as potential targets. Associated with it are current target lists.

(e) Maintain the Target Nominations Briefing Map. This map is used to display the locations of targets nominated for attack on the next day's preplanned ATO. It will display airfields, missile and AAA sites, electronic weapon systems, threat envelopes, and proposed targets.

(f) Monitor mission results. Results obtained from air crew messages, intelligence reports, and reconnaissance mission results are analyzed to determine the degree of success of the attack. Target damage assessments are made, and targets are identified for reattack.

(g) Coordinate data collection requirements. Pre-attack, post-attack, and route area imagery reconnaissance coverage are recommended to the Collection Management Branch.

2.2.2.4 Data Services Branch. This branch provides operational software and hardware support for the Display Control/Storage and Retrieval (DC/SR) equipment. The branch processes most of the intelligence reports that are originated by or received by the TACC. Duties of the personnel in this branch are determined by the nature of the DC/SR, which is not widely implemented and which may be replaced. A similar organization would presumably always be necessary to supervise the flow of digital information throughout the TACS.

2.2.3 Combat Operations Division. This division supervises the execution of the Air Tasking Order. It controls and coordinates the activities of all subordinate combat units under the direction of the COMTAF and his senior staff officers.

2.2.3.1 Organization. A typical organization of the Combat Operations Division is shown in Figure 8. It generally parallels that of the Combat Plans Division. Both have elements devoted to each of the TAF combat functions, but an exact correspondence between functions and staff elements is not evident in the present organizations. In any given tactical situation, some of the support functions are exercised infrequently or not at all, while several support functions appear to be supplied by a single type of flying unit. The organizations of both divisions can be adjusted to the demands of the specific tactical situation.

Figure 8: TACC Combat Operations Division Organization

2.2.3.2 Duties. The staff is comprised primarily of duty officers, each of whom monitors the flying units responsible for executing one or more of the combat functions. The duty officers maintain direct radio and telephone contact with subordinate units to monitor the progress of missions, to assess the success of missions, and to evaluate the capabilities of aircraft, aircrews, and airfields to undertake future missions. The duty officers may take corrective action within certain limits, or the COMTAF or one of his deputies may personally direct employment of forces through the duty officers. Non-commissioned officers of this division maintain display boards which show the status of all flying units and the mission schedules.

2.2.4 Tactical Fusion Division. The principal assignment of this division is to support the Combat Operations Division by receiving, analyzing, and distributing battlefield information and intelligence. This division also provides current intelligence to other components of the TACC and the JTF. Prior to hostilities, this division produces indications and warning intelligence. During hostilities it detects immediate threats to friendly forces and issues threat alerts. The division also works closely with the Target Intelligence Branch to identify and nominate targets for reconnaissance or attack. During the tactical operation, this division presents current intelligence to the entire TACC staff on the Theater Situation Display and the Forward Area Display. These are large wall-mounted maps upon which symbols are continually adjusted to depict the current battlefield situation.

A typical organization of the Tactical Fusion Division is shown in Figure 9. The two intelligence analysts are assisted by non-commissioned officer specialists who collect, organize and display information. This organization will also be adapted to the specific tactical situation.

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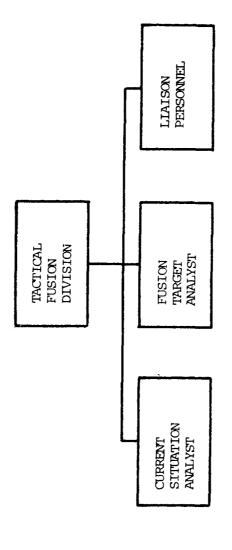
Figure 9: TACC Tactical Fusion Division Organization

2.3 <u>Wing Operations Center organization</u>. It has already been stated that the wing is the principal tactical air unit of the TAF, and the Wing Operations Center (WOC) is the facility from which the wing commander directs his resources. The WOC is directly subordinate to the TACC, and it normally maintains both radio and telephone communication with the TACC and with many other elements of the TACS. The number and type of flying squadrons that comprise the wing will vary with TAF mission and objectives. For this reason, the staffing of the WOC will also vary in size and in duty assignments. A typical WOC organization is illustrated in Figure 10 and described in the following paragraphs. All other facilities of the TACS will have operations centers similar to that of the WOC.

2.3.1 WOC duty officer element. This element reports to the TACC the status of all aircraft, aircrews, airfields, munitions, and fuel. It receives and reviews the Air Tasking Order, relays assignments to subordinate units, and coordinates with the TACC on problems with missions. It maintains contact with aircraft in flight and reports mission status to the TACC.

2.3.2 Intelligence element. This element maintains enemy order of battle and current intelligence files and displays. It receives intelligence reports from the TACC and sends selected portions to subordinate units. It derives information from aircrew debriefings and submits intelligence reports to the TACC. This element also conducts the WOC targeteering and weaponeering intelligence activities.

2.3.3 Ground liaison element. This element maintains friendly force order of battle. It coordinates with units of other armed services to provide or request operational support. It also maintains a map display of the friendly situation including the FEBA the FLOT, the FSCL, and any other lines of demarcation.

2.3.4 Maintenance element. This element coordinates with all subordinate flying units on all aspects of equipment maintenance. It periodically reports maintenance status to the TACC.

2.3.5 Resources management element. This element maintains records of the expenditure and availability of munitions, fuel, and lubricants. It reports this information to the TACC.
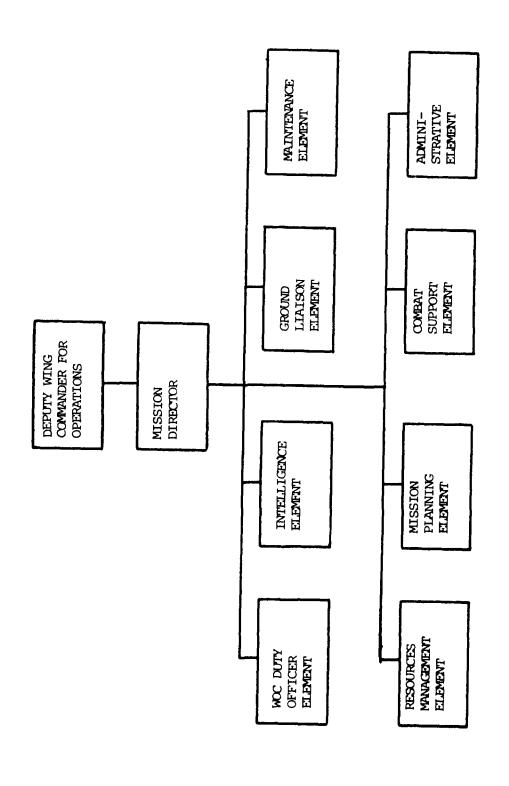
Figure 10: Wing Operations Center Organization

2.3.6 Mission planning element. This element receives
the ATO and breaks out the portion that applies to the local
wing. It reviews the combat situation and the facilities status
provided by other WOC elements. It develops an optimum routing
giving consideration to many details including threat locations,
terrain and weather features, fuel availability, aircraft
capability, and support unit requirements. Most of these
factors have been also considered by the TACC during ATO
preparation. The mission planning element creates detailed
mission schedules for transmission to all flying and support
units.

2.3.7 Combat support element. This element handles airbase
operations including security police, disaster preparedness,
civil engineering, and airfield status.

2.3.8 Administrative element. This element handles all
administrative services for other WOC staff elements.

2.4 TACS command and control tasks. Simply stated, the
purpose of the Tactical Air Force is to employ aircraft to
accomplish a specific combat objective. The combat functions
available to achieve this purpose have been described, and an
organization capable of executing these functions has also been
described. The organization contains two types of individuals;
those few who execute the aerial tasks, and all of the others
who support those tasks. Within the support group are those
individuals who plan the aerial tasks, monitor the execution,
and record the results. Their tasks will be described here
because many of them can be helped with data processing
equipment. These tasks as a whole are often called the command
and control tasks.

It will be shown that the command and control tasks are, in general, independent of the specific TAF objective and of the particular combat functions necessary to achieve that objective. They are also independent of the details of the personnel organization, although an organization must be provided to implement them and the conventional command structure must be observed. The command and control tasks do, however, depend upon a continuous flow of information inward to the various command centers and a corresponding flow of orders outward to the operating units. The nature of the information, the procedures for using that information, and the structure of the resulting orders are all clearly specified in official documents. The command and control network is, in fact, a highly structured manual data processing system that could be readily converted into an automated system.

In the following paragraphs, 15 command and control tasks are described in terms of the information that they handle. Each task receives input information, processes it in some manner, and produces output information. Each segment of output information becomes input to another task so that the entire command and control operation consists of a repetitive cycle of tasks. Information can appear as a data message, as an order or command, as a visual display, as a printed report, or as a file containing many messages or reports. Both data messages and commands are assumed to be those defined by the Joint Interoperability of Tactical Command and Control Systems (JINTACCS) organization for use by all U.S. and NATO services. These formats have seen little or no use in the field at this time, but they have been approved in principle by the Air Force. An explanation of JINTACCS terminology and procedures is provided in Appendix B. Some of the JINTACCS message formats used by the TAF command and control tasks are described in Appendix C. The contents of these formats as they would appear in a data processing system are listed in Appendixes D and E.

The visual displays and printed reports that also constitute information elements are those now used by the TAF according to TAC REG 55-45 (draft). The use of these elements is clear, but the actual data contents will vary to conform to the JINTACCS structure of the message information. The data files that are named herein are not explicitly described in any Air Force documentation although they represent collections of data that often appear as visual displays and printed reports. The use of files in this discussion tends to simplify the descriptions of information flow. It also prepares for the design of data processing programs to implement the command and control tasks.

For the purpose of explanation, the 15 tasks can be divided into four groups. These are:

(a) Mission control tasks
(b) Current information reporting tasks
(c) Background information maintenance tasks
(d) Information analysis tasks

Since all of the activities of all elements of the TACS are ultimately directed to sending aircraft on missions, the central group is the mission control tasks. The other groups provide the information that permits the planning and execution of missions. Some of the information is background that seldom changes and that is produced by agencies outside the TACS. More important is the current information that gives a snapshot of the tactical situation. It permits evaluation of the success of the previous mission, and it determines the plan for the next mission. Finally, intelligence is created by combining various kinds of information through the application of standard procedures tempered by human judgment. This type of information is produced when, for example, a few of the known enemy installations are selected as targets for offensive missions, and those targets are ranked according to relative importance. Figure 11 depicts the cyclical process of sending missions and gaining information to support new missions.

2.4.1. Mission control tasks. The four mission control tasks are performed consecutively and are, of course, interdependent. Requests for missions are received, missions are planned, resources are tasked to execute the missions, and finally the execution of the missions is monitored and controlled.
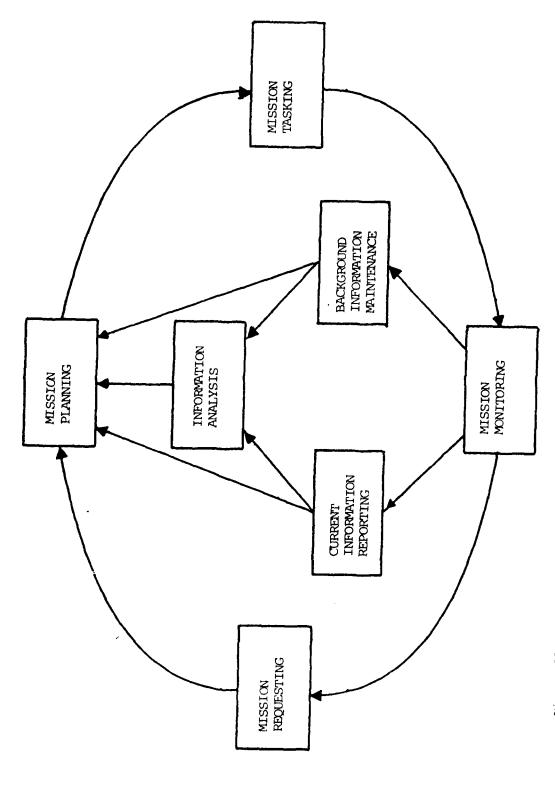
Figure 11: The Command and Control Cycle

2.4.1.1 Mission request processing. Missions are identified by the TAF functions that they perform and therefore by the type of aircraft that fly them. Many missions are preplanned to meet the provisions of the Operations Order that describes in general terms the COMTAF's objectives. Other missions are immediate in nature and are requested on a daily basis by various components of the JTF and the TAF to support their own objectives. The requests are submitted to the TACC over TACS communication channels in standardized message formats. The requests are checked for completeness and relevance, are segregated by mission type, and are combined with similar requests. The pertinent details of all mission requests are posted on display boards that serve as input to the mission planning task. Some requests may be rejected at this time due to lack of appropriate resources or because of conflict with the commander's order regarding apportionment of resources. A message is sent to each requestor to advise whether or not the request is still under consideration. The information formats that are used by this task are listed in Table 1.

2.4.1.2 Mission planning. The daily process of mission planning depends upon the availability of many kinds of information. The current status of all enemy elements in an area of several hundred square miles must be known. Some of these elements are designated as targets for aerial attack while others are identified as threats to attack missions. The locations and intentions of friendly units in the area must be known, and significant terrain and weather conditions must be considered. The current status of aerial resources must be known in terms such as the numbers and types of aircraft and the quantities of fuel and munitions. The summarized requests for missions are balanced against this aggregate of information to produce a general mission plan that best fits the COMTAF's objectives. The plan is formulated at the TACC into the Air Tasking Order (ATO) and is transferred in whole or in part to all elements of the TACS and to lateral and higher commands. Subsidiary activities produce responses to mission requests, create new requests for information collection, and generate summary activity reports for higher headquarters. The information formats used by this task are listed in Table 2.

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2.4.1.3 Mission tasking. Receipt of the tasking orders (ATOs) at the various WOCs initiates the detailed planning necessary to implement individual missions. Specific squadrons, aircraft, and aircrews are assigned to the missions, and detailed flight plans are worked out by each aircrew to include such items as times, headings, communications frequencies, and the operating parameters of electronic equipment and armament. This task requires access to much of the same information that contributed to the mission planning task. The geographic area of interest of each individual WOC may be smaller than that of the TACC, but more detailed information may be required within that area. Information displays similar to those at the TACC are maintained at each WOC. The information formats used by this task are listed in Table 3.

2.4.1.4 Mission monitoring. Radio contact is maintained insofar as possible with mission aircraft by both ground and airborne control stations during the period from take-off to landing. Many message formats are specified for the mission monitoring task to standardize the type of information to be exchanged and to facilitate control and coordination of the aircraft. The current status of each mission is continually displayed at the WOC and the TACC as well as at many of the other elements of the TACS. The observations of the aircrew regarding such things as enemy disposition, threat locations, potential targets, and bomb damage assessment are an important source of the information that will guide subsequent missions. These observations may be transmitted while in flight or may be elicited during debriefing. The information is fitted into the format of one or more standard messages for transmission throughout the TACS. The formats used by the mission monitoring task are listed in Table 4.

2.4.2 Current information reporting tasks. Current information is that which is derived from observations of the battlefield and from routine reports of task force components. This information is divided for convenience in handling into the categories of TAF resources availability, friendly forces disposition, and enemy forces disposition.

2.4.2.1 TAF resources availability. The resources are the aircraft, aircrews, fuel, armament, and the specialized reconnaissance, surveillance, and electronic warfare equipment. Several different message formats are specified to permit reporting the information necessary to describe the status of different types of units. The TACC maintains display boards showing the status of all units in the TACS, while each WOC displays similar information about its own subordinate units. The WOCs send status messages to the TACC both on a routine schedule and as necessary to advise of status changes. The information formats used by this task are listed in Table 5.

2.4.2.2 Friendly force disposition. For the planning of some types of aerial missions, it is necessary to know the locations and probable movements of friendly ground forces. This information is reported informally through elements such as the ASOC and the MPC that are responsible for maintaining communication with all friendly ground and naval forces in the JTF or in the general area of interest. Friendly force disposition is often summarized for planning and coordination purposes by defining lines of demarcation that are expressed as strings of coordinates and drawn on map displays at the TACC and the WOCs. Few information formats have been specified for transmitting friendly force disposition. These formats are listed in Table 6.

2.4.2.3 Enemy force disposition. The mission planning process obviously requires detailed current information about the enemy. A principal source of this information is provided by the regular TAF reconnaissance missions. Other sources are the reconnaissance efforts managed at the theater and national levels. Observations made by mission aircrews and by allied ground forces often provide useful information. A large group of message formats has been specified for standardizing the reporting of enemy force disposition. The messages are transmitted throughout the TACS, and the information is usually expressed graphically on map displays. This information not only contributes directly to the mission planning task, but it also provides the basis for the three information analysis tasks described in Paragraph 2.4.4. The examination and analysis of enemy information always results in the generation of requests for reconnaissance missions to be conducted not only by the TAF but also by other JTF components and by national agencies. The information formats used for enemy force disposition reporting are listed in Table 7.

2.4.2.4 Weather forecasts. Weather information is transmitted regularly throughout the TACS over a radio teletype network dedicated to this service. The information is usually posted on a display board at the TACC and at the WOCs so that it is readily accessible to all personnel. The JINTACCS formats used for weather forecasts are listed in Table 8.

2.4.3 Background information maintenance tasks. Background information is that which does not change from day to day. It is usually obtained prior to the tactical action, and it often consists of voluminous technical reports and documents.

2.4.3.1 TAF resources capabilities. Mission planning and tasking require a detailed technical knowledge of the capabilities of various types of aircraft, airborne sensors, and weapons. Although the planning officers are often experienced aircrew members, they must occasionally refer to technical manuals for the necessary information. A list of the publications prescribed for use at the TACC is given in Table 9. Some or all of these are probably needed at the WOCs and at most other unit headquarters.

2.4.3.2 Terrain description. Knowledge of terrain features is obtained from printed maps that are carried by every unit. Map sections are routinely combined into wall-mounted displays that cover the entire area of interest. Symbols to depict important elements of current information are positioned manually on these displays. The principal map displays at the TACC are the Forward Area Display and the Theater Situation Display. Similar map displays are maintained at each WOC and at the headquarters of many other units.

2.4.3.3 Friendly force capabilities. Mission planning sometimes requires a technical knowledge of the capabilities available within naval and ground forces that may be components of the JTF. Aircraft, airborne sensors, and weapons employed by other services might be capable of complementing and supplementing those of the Air Force. There appears to be no formal method of obtaining information of this sort except through liaison officers from other services who are assigned to the TACC.

2.4.3.4 Enemy force capabilities. Information about specific enemy units, weapons, equipment and personnel is collected routinely from many sources. It is essential to mission planning because it permits the selection of targets and the assessment of enemy resistance to attack. Some of this information is stored in computer files at the national and theater levels, but it is now available to tactical units only in printed form.

2.4.4 Information analysis tasks. It is difficult to enumerate tasks in this group because they all require the application of human judgement and experience to all of the available current and background information. Three of the tasks can be described in some detail because much of the judgement and experience has been incorporated into fairly complex sets of rules and procedures for information analysis. Attempts have been made to implement the routine portions of these tasks with computer programs, but no automated assistance is yet available at the tactical airbase

2.4.4.1 Threat assessment. Aerial missions must be planned to avoid, insofar as possible, known enemy defenses such as missile launch sites and anti-aircraft artillery. The locations are obtained as current information from reconnaissance sources or from air crew observation. The actual capabilities of weapons are obtained from back ound information files. This information may be combined to roduce an estimate of the probability of success in neutralizing or circumventing these threats or in attacking despite them.

2.4.4.2 Target nomination. Targets for aerial attack may be fixed installations such as factories, dams and railheads about which much background information is available. Targets may also be mobile units whose locations are items of current information but whose capabilities and potential threats may be supplied from the background information files. The relative importance of the available targets must be estimated in terms of the COMTAF's current objectives. The selection of targets for attack must be made with consideration for the known threats and the capabilities of the resources available to the TAF. Some of the information can be reduced to numerical values, but the final selection of targets requires human judgement.

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2.4.4.3 Penetration analysis. After a target has been
selected and the known threats have been analyzed, a routing for
mission aircraft may be planned. The plan must consider such
factors as the range and altitude capabilities of TAF aircraft.
It must provide for the use of all available threat avoidance
and neutralization capabilities. Two or more feasible routes
may be developed by routine analysis methods, but the final
choice of route must be made through human judgement.

2.5 Present Tactical Data Processing Systems. The Data
Control, Storage and Retrieval System (DC/SR) is the only
computer system now available to support the TAF in the field.
It is intended to be deployed with the TACC, and it receives
information over tactical telephone channels from remote
teletype terminals. The Computer Assisted Force Management
System (CAFMS) is now under development at Langley Air Force
Base. It wil include a computer complex at the TACC and a large
number of intelligent terminals to be deployed with other TACS
components. It will communicate over tactical telephone
channels and will support the construction and distribution of
the Air Tasking Order. Neither the DC/SR nor CAFMS is
microcomputer based, and therefore neither is well suited to the
tactical environment.

TABLE 1
MISSION REQUEST PROCESSING DATA FORMATS

MISSION REQUESTS

A425	ERTM	Elint Requirement Tasking Message
D100	JTACARSREQ	Joint Tactical Air Reconnaissance/ Surveillance Request
D120	JRSRR	Joint Remote Sensor Report/Request
D200	JCASINTREQ	Joint Close Air Support/Interdiction Request
D630	ALREQ	Airlift Request
D634	HELOALREQ	Helicopter Airlift Request
D660	JAIRREQ	Joint Air Mission Request
D666	JESCREQ	Joint Escort Request
D667	JRECREQ	Joint Reconnaissance/Surveillance Request
D668	JSUPREQ	Joint Support Request

REQUEST RESPONSES

A651	EMPLOYALOC	Air Employment/Allocation Plan
A661	REQSTSTSK	Air Mission Request Status/Tasking Message
B702	JLNCHREP	Joint Launch Report
D120	JRSRR	Joint Remote Sensor Report/Request
F625	REQCONF	Request Confirmation Message
F631	ALMSNSCD	Airlift Mission Schedule
F636	HELOALCONF	Helicopter Airlift Mission Data Confirmation Message
F654	CROSSCONF	Cross-Force Mission Data Confirmation Message

DATA FILES OUT

Mission Status
Sortie Employment
Mission Request

TABLE 2
MISSION PLANNING DATA FORMATS

COMMANDS IN

A421	EXORD	Execution Order
A422	FRAGORDER	Operation Fragmentary Order
A650	APORALOT	Apportionment/Allotment Message
A690	TACOPDAT	Tactical Operational Data Message
A691	TECHOPDAT	Technical Operational Data Message
C440	RPTMINEOPS	Report Intention/Completion of Minefield
E400	OPLANCHG	Operations Plan Change
E445	STRIKEWARN	Friendly Nuclear Strike Warning
F750	DESIGAREA	Designated Area Message

DATA FILES IN

Mission Status
Sortie Employment
Mission Request
Theater Situation Display
Forward Area Display
Rescue Status
TACS Facility Status
Tactical Unit Status
Tactical Unit Munitions Status
Air Defense Fighter Status Display
SAM/ADA Weapons Status
Airbase/Flight Facility Status

MISSION REQUESTS OUT

A651	EMPLOYALOC	Air Employment/Allocation Plan
D200	JCASINTREQ	Joint Close Air Support/Interdiction Request
D260	RFR	Request For Report
D630	ALREQ	Airlift Request
D634	HELOALREQ	Helicopter Airlift Request
D660	JAIRREQ	Joint Air Mission Request
D666	JESCREQ	Joint Escort Request
D668	JSUPREQ	Joint Support Request

REQUEST RESPONSES OUT

A661	REQSTSTSK	Air Mission Request Status/Tasking Message
F625	REQCONF	Request Confirmation Message

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TABLE 2   (cont.)
MISSION PLANNING DATA FORMATS

F631   ALMSNSCD   Airlift Mission Schedule
F636   HELOALCONF   Helicopter Airlift Mission Data
                          Confirmation Message
F654   CROSSCONF   Cross-Force Mission Data Confirmation

COMMANDS OUT

A421   EXORD   Execution Order
A422   FRAGORDER   Operation Fragmentary Order
A440   WARNORD   Warning Order
A651   EMPLOYALOC   Air Employment/Allocation Plan
E400   OPLANCHC   Operations Plan Change
F401   EWEM   Electronic Warfare Employment Message

SUMMARY REPORTS OUT

C400   SITREP   Commander's Situation Report
G423   OPSUM   Operations Summary Report
G424   EWMSNSUM   Electronic Warfare Mission Summary

DATA FILES OUT

Fighter Mission Schedule Display
Reconnaissance Mission Schedule Display
Airlift Mission Schedule Display
Tanker Mission Schedule Display
Support/C3CM Mission Schedule Display
ATO Production Display

TABLE 3
MISSION TASKING DATA FORMATS

COMMANDS IN

A421	EXORD	Execution Order
A422	FRAGORDER	Operation Fragmentary Order
A440	WARNORD	Warning Order
A635	HELOALDAT	Helicopter Airlift Mission Data Message
A652	SORTALOT	Sortie Allotment Message
A653	CROSSDAT	Cross-Force Mission Data Message
A770	ALORD	Alert Launch Order
E400	OPLANCHG	Operations Plan Change
E402	EWAM	Electronic Warfare Approval Message

DATA FILES IN

Fighter Mission Schedule Display
Reconnaissance Mission Schedule Display
Airlift Mission Schedule Display
Tanker Mission Schedule Display
Support/C3CM Mission Schedule Display
Forward Area Display
Theater Situation Display

REQUEST RESPONSES IN

B702	JLNCHREP	Joint Launch Report

MISSION REQUESTS OUT

A425	ERTM	ELINT Requirement Tasking Message
A653	CROSSDAT	Cross-Force Mission Data Message

COMMANDS OUT

A635	HELOALDAT	Helicopter Airlift Mission Data Message
A653	CROSSDAT	Cross-Force Mission Data Message
A661	REQSTATASK	Air Mission Request Status/Tasking Message
A770	ALORD	Alert Launch Order
A900	ADSCRAMORD	Air Defense Scramble Order
A901	SARSCRAMORD	Search and Rescue Scramble Order
A902	TNKSCRAMORD	Tanker Scramble Order
A903	CASSCRAMORD	Close Air Support Scramble Order
E710	AIRDEFCOM	Air Defense Command Message
F654	CROSSCONF	Cross-Force Mission Data Confirmation

TABLE 4
MISSION MONITORING DATA FORMATS

DATA FILES IN

Fighter Mission Schedule Display
Reconnaissance Mission Schedule Display
Airlift Mission Schedule Display
Tanker Mission Schedule Display
Support/C3CM Mission Schedule Display

DATA MESSAGES IN

B703	AIREVENT	Significant Air Event Report
B750	JINFLT	Joint Inflight Report
C240	FMR	Forward Air Controller Mission Report
C420	SARSIT	Search And Rescue Situation Summary
C482	SARIR	Search And Rescue Incident Report
C900	TAKEOFFREP	Take Off Report
C901	LANDINGREP	Landing Report
C902	ABORTREP	Abort Report
C903	TNKINFLTREP	Tanker Inflight Report
C904	AIRDELAYREP	Air Delay Report
C905	GNDDELAYREP	Ground Delay Report
C908	ARRIVALREP	Arrival Report
C909	DEPARTUREREP	Departure Report
C910	ADVISORYREP	Airlift Advisory Report
C913	CGOEXCREP	Cargo Exception Report
C926	TACACTIONREP	Tactical Action Report
C927	OFFACTIONREP	Offensive Action Report
C928	WEACOMITREP	Weapons Commitment Report
C929	ECTARREP	Electronic Tactical Action Report

TECHNICAL CONTROL MESSAGES

B711	ENGSTS	Engagement Status
C906	DISTRESSREP	Aircraft in Distress Report
C907	DOWNEDPIREP	Downed Pilot Report
C914	INITIALREP	Initial Report
C915	UPDATEREP	Update Report
C916	CORECMREP	Correlated ECM Report
C917	UNCORECMREP	Uncorrelated ECM Report
C918	ECMTERMREP	ECM Termination Report
C919	ORBITREP	Orbit Report
C920	SPLITTRKREP	Split Track Report
C921	MERGTRKREP	Merging Track Report

TABLE 4 (cont.)
MISSION MONITORING DATA FORMATS

C922	MASSTRKREP	Mass Track Report
C923	IFFEMERGREP	IFF Emergency Report
C924	CONTACLSTREP	Contact Lost Report
C925	EMERGREP	Emergency Report
E706	INITHAND	Initiate Handover Message
E707	RECHAND	Receive Handover Message
E710	ARDEFCOM	Air Defense Command Message
E715	AIRDEFWARN	Air Defense Warning Message
E900	MSNACFTMSG	Mission Aircraft Message
E901	MSNCNTRLMSG	Mission Control Message
F632	FLTCONTINFO	Flight Control Information Message
F751	ECMDAT	ECM Data Message
F752	TRKMAN	Track Management Message
F753	TRKREP	Track/Point Report
F754	FLTPLAN	Flight Plan Message
F755	TRKINTEL	Track Intelligence Message

TABLE 5
TAF RESOURCES AVAILABILITY DATA FORMATS

DATA MESSAGES IN

B704	ABCHANGE	Airbase Change Report
B705	ACSAMSTAT	Alert Aircraft/SAM Status Report
B900	TACOPLINEUP	Aircraft Lineup Report
B901	UNITSTATREP	Tactical Unit Status Report
B902	FCLTYSTATREP	TACS Facility Status Report
B903	RESUSTATREP	Rescue Unit Status Report
B904	CNTRLCAPREP	Control Capability Report
B905	ALCESTATREP	Air Lift Control Element Status Report
B906	CCTSTATREP	Combat Control Team Status Report
B907	ARPSTATREP	Aerial Port Equipment Status Report
B908	CASALSTATREP	Close Air Support/Alert Status Report
B909	TACMUSTATREP	Tactical Unit Munitions Status Report
B910	AIRDEFFTRSTAT	Air Defense Fighter Status Report
B911	SAMSTATREP	SAM/ADA Weapon Status Report
C460	COMSPOT	Communications Spot Report
C490	OPREP-3PNF	OPREP-3 Pinnacle/NUCFLASH
C491	OPREP3-PFB	Pinnacle/Front Burner
C492	OPREP-3PED	OPREP-3 Pinnacle Emergency/Destruction
C493	OPREP-3PEV	OPREP-3 Pinnacle/Emergency Evacuation
C494	OPREP-3PBA	OPREP-3 Pinnacle/Broken Arrow
C495	OPREP-3BS	OPREP-3 Bent Spear
C496	OPREP-3FG	OPREP-3 Faded Giant
C928	WEACOMITREP	Weapons Commitment Report
C929	ECTARREP	Electronic Tactical Action Report
G424	EWMSNSUM	Electronic Warfare Mission Summary

DATA FILES OUT

Air Defense Fighter Status Display
SAM/ADA Weapons Status Display
Airbase/Flight Facility Display
TACS Facility Status
Tactical Unit Status
Tactical Unit Munitions Status
Rescue Status

TABLE 6
FRIENDLY FORCE DISPOSITION DATA FORMATS

DATA MESSAGES IN

A210	FMC	Fire Mission Command
A260	FSC	Fire Support Coordination Measures Report
A690	TACOPDAT	Tactical Operational Data Message
B260	FRD	Friendly Unit Location
C440	RPTMINEOPS	Report Intention/Completion of Minefield
C441	NBC4	NBC4 Report
C442	NBC3	NBC3 Report
C444	NBC5	NBC5 Report
F750	DESIGAREA	Designated Area Message

DATA FILES OUT

Forward Area Display
Theater Situation Display

SUMMARY REPORTS OUT

C400	SITREP	Commander's Situation Report
C420	SARSIT	Search And Rescue Situation Summary Report
G423	OPSUM	Operations Summary

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TABLE 7
ENEMY FORCE DISPOSITION DATA FORMATS

DATA MESSAGES IN

A100	TARBUL	Target Bulletin
B703	AIREVENT	Significant Air Event Report
B750	JINFLT	Joint Inflight Report
C100	IPIR	Initial Photo Interpretation Report
C101	SUPIR	Supplemental Photo Interpretation Report
C102	MIPIR	Multi-Mission Imagery Photo Interpretation Report
C110	INTREP	Intelligence Report
C111	TACREP	Tactical Report
C112	TGTINFOREP	Target Information Report
C113	HOTPHOTOREP	Hot Photo Report
C120	MIJIFEEDER	Meaconing, Intrusion, Jamming Interference Report
C121	TACELINT	Tactical ELINT Report
C130	MISREP	Mission Report
C131	SENREP	Sensor Report
C240	FMR	Forward Air Controller Mission Report
C451	VULWARN	Vulnerability Warning Message
C485	NBC1	NBC1 Report
C486	OPREP-3P	OPREP-3 Pinnacle
C487	OPREP-3	OPREP-3
C927	OFFACTIONREP	Offensive Action Report
C928	WEACOMITREP	Weapons Commitment Report
C929	ECTARREP	Electronic Tactical Action Report
E715	AIRDEFWARN	Air Defense Warning Message
F751	ECMDAT	Electronic Countermeasures Data Message
F755	TRKINTEL	Track Intelligence Message
G424	EWMSNSUM	Electronic Warfare Mission Summary
G480	NBC2	NBC2 Report

REQUEST RESPONSES IN

D111	RRII	Response to Request for Intelligence Information

MISSION REQUESTS OUT

A425	ERTM ELINT	Requirement Tasking Message
D100	JTACARSREQ	Joint Tactical Air Reconnaissance/ Surveillance Request
D110	RII	Request For Intelligence Information

TABLE 7 (cont.)
ENEMY FORCE DISPOSITION DATA FORMATS

D120   JRSRR   Joint Remote Sensor Report/Request
D667   JRECREQ   Joint Reconnaissance/Surveillance Report

SUMMARY REPORTS OUT

G130   DISUM   Daily Intelligence Summary
G131   INTSUM   Intelligence Summary
G424   EWMSNSUM   Electronic Warfare Mission Summary

DATA FILES OUT

Forward Area Display
Theater Situation Display

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TABLE 8
WEATHER FORECASTS DATA FORMATS

DATA MESSAGES OUT

C520	SEVERE STORM	Severe Storm Warning
C521	WXFCST	Weather Forecast
C522	WXRPT	Weather Report
C523	PTWXWARN	Point Weather Warning

DATA FILES OUT

Weather Forecast Display

TABLE 9
TAF RESOURCES CAPABILITIES DATA FILES

TAC Tactical Electronic Warfare Analysis (TEWA) Chart
TACM 3-1, Vol. I, Tactical Fighter Weapons Equipment
Weapons Delivery Tactics
Weapons Delivery Programs (-34, -25 Tech Orders)
Weapons Delivery Limitations (-1 Tech Orders, Sec 5)
Aircraft Performance Data (-1 Tech Orders)
TAC 200-3 Collection Management Guide
Joint Munitions Effectiveness Manuals

TABLE 10
ENEMY FORCE CAPABILITIES DATA FILES

Air Order of Battle Listing
Missile Order of Battle Listing
Electronic Order of Battle Listing
Command, Control, and Communications Order of Battle Listing
Naval Order of Battle Listing
National Intelligence Survey (NIS) - Basic Fact Book
Military Intelligence Survey (MIS)
DIA Fact Book
DIA Aircraft Handbook - ECC
DIA Aircraft Handbook - Free World
DIA Aircraft Armament Handbook - ECC
DIA Aircraft Armament Handbook - Free World
DIA Defense Missile System Handbook
DIA Ground Launched Guided Missile Systems Handbook -
        USSR and PCR (FTD)
DIA Radar Handbook, Vols. I-IV
DIRNSA ELINT Parameter Limits (EPL) List

3. MICROCOMPUTER SURVEY

3.1 Introduction.

3.1.1 Purpose. The purpose of the survey is to identify commercially available data processing equipment that could be used as a test bed for establishing the functional requirements of components of the Tactical Air Control System (TACS). The data processing equipment is to be based upon a microprocessor and is to be capable of providing digital communication through existing tactical communication facilities. In addition to its function as a communication "front end", the equipment is also to provide a stand-alone data processing capability during those periods of deployment when communication to other TACS components is not available. The data processing equipment as a whole has been designated the Microprocessor Front End Terminal (MFT).

3.1.2 Approach. In general, the approach was to assume that certain standard components must be included in the system, to establish some selection criteria for these components, and to identify suitable sources of information about them.

3.1.2.1 System components. A preliminary investigation revealed that there are several tasks at each tactical headquarters that could be effectively supported by a data processing system. Many similar tasks have been automated with large scale computers and more recently with minicomputers. The presently available systems are not satisfactory for use at the tactical air base because they are too large and too fragile for air transport. Most of them require filtered, conditioned air and more electrical power than can be provided under tactical conditions. The use of integrated circuit chips avoids all of the problems inherent in the systems now available. The basic requirement is for a general purpose computer system that offers all or most of the advantages of modern integrated circuit technology while providing all of the data processing functions of the typical minicomputer system. A general purpose microcomputer system is assumed to comprise at least the following components:

  (a) A central processing unit (CPU) containing the
       microprocessor and the support chips necessary to
       make it a programmable computer.
  (b) Main memory for the temporary storage of 64K bytes or
       more of programs and data.

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(c) Mass memory for the permanent storage of 10 to 20 megabytes of programs and data.

(d) At least one interactive user terminal including a keyboard and a display device such as a cathode ray tube.

(e) A printer for copying stored data on paper.

(f) From four to twelve serial input-output ports in addition to those necessary for the peripheral devices listed above.

3.1.2.2 General selection criteria. The MFT is viewed as a test bed for establishing detailed requirements through experimentation. Since quantitative performance requirements have yet to be established, there appears to be no need to provide for experimentation with the most recently announced developments in microcomputer technology. Equipment in this category is expensive, not readily available, and is itself in an experimental stage. The decision was made to seek a microcomputer system that satisfied the following criteria:

(a) All components of the system should be available from the same vendor. This assures that the components have been designed to function together and have been tested as a system before delivery. It is unlikely that all of the components would actually be manufactured by the vendor.

(b) The system should be now in use by several customers and should be offered for "off-the-shelf" delivery. Relatively few microcomputer systems have been sold for business and professional use, so production problems may be encountered despite this stipulation.

(c) The vendor should be capable of providing initial system checkout and integration. He should also offer on-call maintenance service and a stock of replacement parts. It is also necessary to point out that the vendor should show some evidence of financial stability. Most of the systems are offered by companies that were established within the last five years. Many companies have failed, but survival and moderate expansion for about four years seem to offer a reasonable expectation that the vendor will support his product.

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(d) The equipment design should provide for system modification by the addition of a wide range of plug-in modules. A variety of modules should be available from the vendor, but the system should also accept plug-ins offered by other suppliers. This will allow experimentation with the use of various system functions and will also permit the controlled investigation of new technological developments.

3.1.2.3 Data sources. The first step in the microcomputer survey was to obtain nine reports by the Datapro Research Corporation of Delran, NJ. This organization publishes a wide variety of reports on data processing and office system hardware, software, services and companies. Their facilities make it possible for them to collect and collate much more information than could be obtained by any individual. Their tabular presentation of essential facts about nearly all of the microcomputers on the market makes possible a preliminary selection of candidates for the MFT test bed. The Datapro reports are listed in Appendix A. Those that proved to be most valuable for this survey are discussed in Paragraph 3.2.

A supplementary step in the survey was to obtain subscriptions to most of the periodicals that deal with various aspects of the microcomputer industry. These periodicals sometimes publish their own surveys of available microcomputers and peripheral equipment. Their surveys generally contain less information than the Datapro reports, but they sometimes provide more timely information. The principal value of the periodicals lies, however, in the advertisements placed by the many companies who offer one or more products directly related to microcomputers. The appearance of a product in an advertisement does not necessarily mean that the product is currently available or that it will perform as claimed. It does, however, indicate the trends in new equipment development, and it permits planning for future enhancements to a currently available system. The publications that were used are listed in Appendix A. The information presented by them is extremely repetitious, and therefore no specific references are made in the following discussion to any periodicals.

The third source of survey information was the
publications of the various vendors. It is possible to become
inundated with material of this sort to the point where almost
none of it has any impact. The most useful information was
obtained by writing to vendors who were shown by the Datapro
reports to have products with the desired characteristics. In
several cases it was possible to obtain very useful information
from local dealers and distributors. No listing is included of
the manufacturer's literature that was obtained for this survey.
A few specific references are made in the following paragraphs.

At the outset of the survey it seemed advisable to obtain
the technical specifications of all currently available
microprocessor and support chips. "An Introduction to
Microcomputers" in three volumes, by Adam Osborne, provides a
very comprehensive source of this information. It soon became
evident, however, that there was little need to choose between
microprocessor chips because only a few were used in
commercially available general purpose computers. The others
were intended for special purpose controllers, were obsolete, or
were too new to have gained much acceptance by system vendors. A
Datapro report that provides a much simplified comparison of
microprocessor chips proved to be adequate. It will be cited in
the next paragraph.

3.2 <u>Survey of Reports.</u> Nine Datapro reports were obtained
because their descriptions suggested that they could provide
useful information. Examination of these reports led to the
conclusion that it was feasible to base the equipment selection
on the contents of only two of them. The observations that led
to this conclusion are briefly as follows:

3.2.1 "All About Microcomputers", June 1980. This report
contains detailed specifications of 149 microcomputer models
from 49 vendors. All of these models are either currently being
shipped or are due to be delivered shortly. It is evident that
several of the entries could satisfy the preliminary
requirements for an MFT. The discussion in Paragraph 3.4 is
based largely upon this volume.

3.2.2 "All About Personal Computers', May 1980. This report describes 15 microcomputers. Some of these also appear in "All About Microcomputers". Datapro attempts to differentiate between "personal computers" and those supplied to OEMs (original equipment manufacturers). The distinction is very difficult because all of the systems use the same types of microprocessors and all have approximately equivalent data processing capabilities. Datapro suggests that a personal computer is one that sells for $2000 or less and that is sold to non-professional programmers. The major distinction for the purposes of this survey is that none of the low-priced computers offers the necessary expansion capability and flexibility of system configuration. This distinction removes from consideration the Radio Shack TRS-80 that is by far the most widely sold and most widely known microcomputer.

3.2.3 "All About Small Business Computers", January 1980. This report describes 266 data processing systems offered by 71 suppliers. These are general purpose computers, and virtually all of them appear to be capable of meeting the initial requirements stated for the MFT. Many of these business computer systems are built around a microprocessor chip, but the remainder qualify technically as minicomputers rather than microcomputers. Datapro is again unable to make a clear distinction between this and other categories except to point out that business computers tend to be higher priced and to include software and peripheral devices that accommodate business applications. These business computers can be safely excluded from consideration for an MFT test bed because they tend to be too bulky, too fragile, too decorative, and too expensive for use at a tactical unit headquarters.

3.2.4 "All About Communications Processors", May 1980. This report describes 84 units currently marketed by 39 suppliers. None of these is mentioned in any of the previous references although nearly all appear to be microprocessor based. In Datapro's words, "A communications processor, in the context of this report, is simply a digital computer that has been specifically programmed to perform one or more control and/or processing functions in a data communications network". Almost any general purpose computer can be programmed to handle the communication function. The devices in this reference need not be considered for possible use as an MFT for the following reasons:

(a) Many are designed to work as a front end terminal in conjunction with a particular vendor's large scale computer or "mainframe".
(b) Many have "hard-wired logic" that cannot be programmed for other data processing functions.
(c) All are programmed for various commercial communication systems rather than for the military system within which the MFT must operate.

3.2.5 "Microprocessor Specifications", May 1980. This report describes 114 microprocessors from 21 manufacturers. It gives a semi-technical discussion of the important characteristics of microprocessor chips in general, and it gives some assistance in selecting a chip for a particular application. The publication is of limited value to this survey because the large majority of the chips that it describes have not been incorporated into complete systems for use as general purpose computers. Many chips appear to be intended for use in special purpose device controllers. Some of the tabulated items are printed circuit boards that contain not only the microprocessor, but also the interconnections and support chips necessary to make a complete controller. A few of the more versatile microprocessors appear in more than one entry because they are produced by two or more manufacturers and are also incorporated into printed circuit boards.

3.2.6 "All About User-Programmable Terminals", November 1979. This report describes 108 systems from 52 vendors. A check of the tabulated data shows that all of these devices are computers and some appear to qualify as general purpose computers. Datapro offers a lengthy discussion of their reason for separating this group of devices from the business computers, communication processors, personal computers, and microcomputers described in the other reports. The distinction is not very important for the purposes of this survey because the tabulated data can be compared with the general characteristics that have been specified for an MFT. No programmable terminal is found to be suitable, but the comparison is described in Paragraph 3.3 to give some insight into the type of commercial equipment that is available.

3.2.7 Additional reports. Three reports were reviewed but will not be discussed as a part of this survey. They deal with graphic display devices, facsimile devices, and printers. The previously named documents show that it is possible to obtain a complete system from a single vendor. Since this is true, there is little to be gained by selecting equipment from several different vendors. Printers in particular are very competitive, and it is possible to obtain satisfactory devices from several vendors. Graphic displays and facsimile devices are far less common, and suitable equipment may be obtainable only from vendors that specialize in that type of equipment. In any case, the latter two peripherals are not required for the initial implementation of an MFT although they will be recommended for advanced experimentation.

3.3 Survey of User-Programmable Terminals. The Datapro report on 108 programmable terminals tabulates 54 characteristics of these devices in 11 different categories. Some of these characteristics are directly related to the general requirements for an MFT. It was found to be possible to eliminate from further consideration all of the terminals described in those tables. The process of elimination is described in the following paragraphs. The relevant characteristics do not represent all of those given by Datapro and are not presented in the same order. Many of the chosen characteristics are interrelated, and few of the terminals were eliminated on the basis of a single adverse characteristic.

3.3.1 Processor description. The fundamental requirement for an MFT is that it contain at least one microprocessor. Forty five of the 108 terminals are based upon minicomputers and must be eliminated. Minicomputers are usually built with integrated circuit chips of the "discrete logic" variety. They may be faster and more versatile than some microcomputers, but they are also larger and more expensive.

3.3.2 Stand-alone capability. Another fundamental MFT requirement is that it can stand alone as a data processor without support from a host computer. Twenty three of the terminals are regarded by their vendors as being unsuitable for stand-alone use as a small business computer. Thirteen of the 23 contain microprocessors, so that examination of the first two characteristics has eliminated over half of the programmable terminals.

3.3.3 Interactive keyboard display. All of the terminals
include a keyboard to allow the user to communicate with the
computer. Most of them communicate to the user with a display
that probably always consists of a cathode ray tube (CRT)
screen. The remainder communicate to the user with a printer
that operates like an electric typewriter. Printer terminals
are relatively slow, awkward and expensive to use. The MFT
requires the speed and ease of use of at least one CRT display,
and therefore the 15 terminals that provide only printers must
be eliminated. Ten of these were not eliminated by previous
considerations.

3.3.4 Main memory. This is the temporary memory that
contains programs and data during processing. Most modern
processors utilize semiconductor memory which is so inexpensive
that a truly general purpose computer should contain the maximum
that can be handled by most microprocessors. This maximum is
64K bytes, and the charts show that 29 of the terminals cannot
be obtained with this much main memory. It is of interest to
note that two of the Texas Instruments terminals use from 20K to
80K bytes of bubble memory as the main storage. There is no
reason to use bubble memory in the MFT at this time, but it may
soon be an important means of mass storage.

3.3.5 Mass storage. A truly important requirement for the
MFT is that it be capable of storing large amounts of data where
it is readily accessible to the user through the central
processor. This type of storage is called mass storage, and it
provides for placing data in magnetic form on disks, diskettes,
or tapes. Punched paper tapes and punched cards appear to be
used rarely, if at all, with these terminals. Disks come in
several varieties, of which the so-called Winchester disk is the
most modern and probably the most generally satisfactory. Many
disk drives can make at least 20 megabytes of data accessible to
the processor. Diskettes, or floppy disks, are available in
several different configurations and combinations, but they
seldom make more than two megabytes of data available to the
processor.

Tapes are supplied in cassettes, in cartridges, or sometimes on open reels. They can contain very large amounts of data, but the data is not readily accessible to the processor because the tape must be moved by mechanical means. The MFT will require at least 20 million bytes of disk storage and may also require some floppy disk storage. Magnetic tapes, paper tapes, and punched cards are not needed. The Datapro charts show that 79 of the programmable terminals are not capable of using disk drives, although some of these can use floppy or minifloppy diskettes. Of the remaining 29, only nine are claimed to be available with Winchester disks.

3.3.6 Communication parameters. The MFT clearly needs the capability to transmit data over at least one telephone channel. All of the terminals in the Datapro chart have this capability in some form. With one or two exceptions they include interfaces that conform physically and electrically to the RS-232 standard which would be acceptable in an MFT. Only three of them also provide the Mil-188C military standard interface, and those are all minicomputer based. Most of the terminals communicate with ASCII characters, as will the MFT, but nine of them are exclusively IBM-compatible and recognize only EBCDIC characters. Most of the terminals are capable of half duplex or full duplex operation in either a synchronous or asynchronous mode at speeds up to at least 2400 bits per second. These appear to conform to MFT requirements except for the fact that none have been specifically designed to synchronize with military communication equipment.

Some of the terminals have evidently been programmed or wired to respond to one or more of the commercial communication protocols including BSC, SDLC, and HDLC. These are of no value to the MFT which must conform to a military protocol, but this would need careful investigation. More important is the fact that none of these terminals appears to be capable of managing more than one communication channel. It will be shown that the MFT must be capable of using from four to 12 communication channels concurrently. If this were the sole reason for eliminating a terminal from consideration, it would require closer investigation because optional control of multiple channels might be available.

3.3.7 Input-output devices. The MFT clearly needs a
medium speed printer and several serial input-output ports to
which can be connected various peripheral devices. At least one
I/O port may be needed in some circumstances to communicate with
a local or remote Teletype terminal or torn-tape relay center.
One or more ports can be used to drive video monitors for
displaying tabular information, and at least one additional port
will eventually be needed for a data digitizing device.
Forty-one of the terminals provide no spare I/O ports, and many
of the rest appear to provide only one. About 44 of the
terminals appear to be incapable of driving a line printer.
These terminals frequently use serial printers which are much
slower than the typical line printer. Two of the charted
terminals are reported to provide four serial ports, two more
offer up to eight ports, and one claims a "wide selection of
interfaces". In general, it appears that inadequate flexibility
in equipment configuration would be a serious problem in
attempting to use most of these programmable terminals as an
MFT.

3.3.8 Software support. The MFT, like virtually any other
general purpose computer system, requires certain standard
software packages. These are often supplied by the equipment
vendor and are adapted to the particular CPU and set of
peripherals. All of the vendors of the charted terminals
provide some sort of software support, but the descriptions are
necessarily very brief, and there is no way to judge the quality
of the software that is actually provided. Even the judgement
of software quality and applicability is a very subjective
undertaking and should never be the sole basis for system
rejection. However, some observations are possible. The MFT
will be expected to handle communications in real time while
concurrently performing storage, retrieval and processing of
data under the interactive direction of one or more users. In
short, the MFT software must have a multiprogramming or
multitasking capability. The Datapro charts show specifically
that 53 of the terminals are not claimed to have this
capability. Several more can handle only two tasks, and a few
invite further investigation by claiming to handle up to 256
concurrent tasks.

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The MFT would probably be programmed in assembly language where speed of operation and economy of storage are of paramount importance, as in the communication control programs. Most the remaining MFT applications programs could most efficiently be programmed in some higher level language. Selection of such a language is also a subjective matter, but at least several languages should be made available by the equipment vendor. The programmable terminals are obviously intended for business applications, and the languages most often supplied are COBOL, BASIC, RPG, and several obscure variations of these such as TIBOL, KOBOL, Interactive COBOL, and MOBOL. None of these should be chosen for the MFT. FORTRAN is available for a few terminals, and PASCAL is available for fewer still. Either of these could be acceptable for MFT programming depending upon the quality of the specific language implementation.

3.3.9 Microprocessor type. Choice of a specific microprocessor chip remains another subjective activity despite the fact that many articles have been written to compare various devices under many different conditions. As stated above, 73 of the 108 terminals use microprocessors. One terminal uses the 12-bit 6100 chip, and two use a 4-bit-slice chip, the AMD 2900. Seventeen terminals use 16-bit CPU's including the TMS 9900, a special Intel 8000, the Micronova, and the LSI-11 chip set. The remaining CPU's are all 8-bit devices including 27 8080A/8085's, 9 6800's, 5 Z-80A's, and one each of 6512, IMP, and 1802. If a choice were to be made solely upon the type of microprocessor, the following points should be given consideration:

3.3.9.1 Word length. A 16-bit word probably offers some advantages in speed over an 8-bit word. Addressing any location in a 64K main memory requires 16 bits, and it is usually faster to present the address in a single group of 16 bits rather than in two consecutive groups of 8 bits each. The relative frequencies of the system clocks and the inherent speed of the memory chips must also be considered. Certainly there is no justification for the conclusion that a 16-bit word is twice as efficient as an 8-bit word.

Only one chip, the 6100, offers a 12-bit word length.
This chip was designed to make possible a low cost reproduction
of the Digital Equipment Corporation's PDP-8 minicomputer. The
PDP-8 was the first popular minicomputer, and more of them have
been sold than any other minicomputer. A huge library of
programs exists for the PDP-8, and the 6100 chip permits taking
advantage of these programs. The design of the PDP-8 is
primitive in comparison with modern microprocessors, and there
is no reason to consider a 6100 based system for use as the MFT.

3.3.9.2 Popularity. Owing to the explosive growth of
microcomputer technology, it must be assumed that any chip
chosen today will become obsolete in a very few years. This
suggests that a popular chip should be selected because there is
greater likelihood that an upward compatible chip will be
available in the future. Instruction sets are all complex, and
they vary widely in characteristics from one chip to another.
Conversion of programs from one set to another can be difficult
and can produce a loss in efficiency where a gain is expected.
On the basis of the sampling represented by this Datapro
report, the 6100, the AMD 2900, the 6512, the IMP, and the 1802
microprocessor chips should all be avoided because of relatively
low popularity. Other samplings are likely to give similar
results.

3.3.9.3 Obsolescence. The rapid growth of the technology
also suggests that it would be unwise to select a microprocessor
chip that has already been superceded by a newer and more
powerful chip. The 8080 is one of the most widely known and
used chips, and the contents of the Datapro report verify that
statement. The 8080 has been superceded by the 8085 from the
same vendor (Intel) and by the Z-80A from a competitor (Zilog).
The 8085 offers little improvement for the software designer
since only two instructions have been added to the 8080 set.
The Z80A, on the other hand, offers significant improvements,
both electrically and logically. It can also execute all
programs written for the 8080. The Z80A has itself been
superceded by a whole series of 16-bit chips, the Z8000 series.
According to the Datapro report, at least, no programmable
terminals have yet been offered with Z8000 microprocessors. It
may not be advisable to wait for such systems, but it seems
unwise to purchase new equipment that contains an 8080A or 8085
microprocessor when systems are available with the Z80A.

The 6800 chip was introduced at about the same time as the
8080 and was intended to be directly competitive. It never
gained the popularity of the 8080 although it offered several
technical advantages. The design of the 6800 has been improved
in the 6802 and 6809, but the latter two chips do not appear in
off-the-shelf terminals according to this Datapro chart. The
Z80A is a better choice than the 6800 and is the best choice of
all of the 8-bit microprocessors represented in the chart.

3.3.9.4 System architecture. The apparent advantages of
the Z80A can be readily overshadowed by other system
characteristics. The chart shows five systems that contain
Z80As. One of these must be rejected because it does not
possess a CRT-type terminal. The second and third must be
eliminated because they have no disk storage and insufficient
software support. The fourth also lacks software support
because it offers only the BASIC language and what appears to be
a report formatting language that is unique to the vendor. The
fifth Z80A based system has little expansion capability in terms
of input-output ports, and it has no multiprogramming
capability.

3.3.10 Summary. This Datapro report shows that none of the
108 user-programmable terminals can be considered for use as an
MFT. The most common deficiencies are lack of hard disk
storage, lack of sufficient communication capability, and lack
of ability to accommodate additional peripheral devices.

3.4 Survey of 149 Microcomputers. The Datapro report on
149 microcomputers tabulates 61 characteristics of these devices
in 11 different categories. The characteristics are similar to
but not the same as those used to compare the user-programmable
terminals. The evaluation of 61 characteristics is not as
difficult as it might seem because some are of relatively minor
importance and some are redundant. For example, under the
category of "Packaging", the table gives the number of printed
circuit boards that comprise the computer, the size of the
board, the number of chips used, and whether or not a power
supply, a control console, and a cabinet are supplied. The
microprocessor chip is identified, but the chip technology, the
data word size, the instruction word size, the number of
instructions, and the number of registers are also given when
these are all characteristics of the chip.

Examination of the chart shows that many of the microcomputers are not really general purpose computers of the sort needed for an MFT. It is difficult to identify the special purpose devices because vendors are understandably reluctant to place limitations upon their products. Five characteristics were singled out that rapidly cut down the number of entries which deserve detailed consideration. These characteristics are not necessarily the most important for an MFT, and they are not necessarily applied in the order of relative importance. They are, however, essential characteristics that can be examined objectively.

3.4.1 Direct memory access. THe MFT must be capable of managing an intermittent flow of data on a communication channel while concurrently performing other tasks involving the user's interactive terminal and the mass storage device. The most efficient way to coordinate these operations is to include in the system design a direct memory access (DMA) controller chip that moves data from an input-output port to main memory with minimum disturbance to the CPU. Most general purpose computers have this chip as a standard component, but many special purpose devices do not. The chart shows that 48 of the 149 microcomputers have no DMA capability. Two of the most widely distributed microcomputers, the Commodore Pet 2001 and the Radio Shack TRS-80 Model 1 are thus eliminated.

3.4.2 Main memory capacity. The MFT will execute programs of moderate complexity, and these programs will work with large volumes of data from mass storage. The main memory is used to store both programs and data during program operation, so the maximum available size of main memory is required. Any 8-bit microprocessor chip can manage 64K bytes of main memory, so it is reasonable to require that a candidate system be capable of providing that amount. Many systems can be supplied with variable amounts of main memory up to a maximum of 64K, and these systems are not excluded. The chart shows that, of the remaining 101 microcomputers, 26 cannot be obtained with 64K bytes of main memory.

One reason for the lack of main memory is that the system dedicates up to 16K bytes of read-only memory (ROM) to the storage of a BASIC language interpreter. This is a common practice in microcomputers intended primarily for "personal" or non-professional use. BASIC is easy to use, out it produces programs that are far too slow for most of the applications foreseen for the MFT. The very popular Apple Computer must be eliminated for this reason even though it offers a choice of BASIC or PASCAL in ROM.

3.4.3 Vendor stability. The "Comments" category in the chart shows that one vendor (Automated Computer Systems) did not answer inquiries for information in 1980 although it did respond in 1979. Two of this company's products were previously eliminated, but the remaining four products are now eliminated to reduce the number of units still under consideration to 72.

Many of the companies in the microcomputer industry are young and very small. Past experience indicates that some of these will soon disappear through failure, acquisition or reorganization. Even those larger companies that have developed in other industries can abandon their commitment to the microcomputer market on short notice and can leave their products without support. Some observations about other specific companies will be made in the following paragraphs.

3.4.4 Principal application. Many of the devices shown on the chart are manufactured for sale to OEMs who will incorporate them into other products for sale to an end user. Some of these are identified as "single board computers". These are often complex printed circuit boards that contain a microprocessor chip and several support chips including substantial amounts of main memory. They sometimes include a cabinet and a power supply, but they do not include the peripheral devices such as CRT terminals and printers th⁷t   e a complete general purpose computer. Other devices on e ʈ rt are indicated to be "prototyping systems" or "s uːatₒ s" or "teaching aids" or "microcomputer development tₒols". All of these are intended for special applications rather than for general purpose data processing. Forty of the charted devices fall into one or another of these special applications.

In this group are four products of Computer Automation, Inc. These are the "Naked Mini" line of computers. The vendor proclaims them to be minicomputers rather than microcomputers, and they probably shouldn't be listed. In any event they can be excluded because they are offered for sale only to OEMs according to the company's sales brochure.

3.4.5 Microprocessor type. At this point, 35 microcomputers remain as candidates for selection, and it becomes necessary to examine the characteristics that describe the microprocessor itself. It will be shown that 16 8-bit devices and one 16-bit device remain for consideration. The process of selection by type of microprocessor is as follows:

(a) The MP12 by Fabri-Tek, Inc. contains a CPU made up of small scale and medium scale integrated circuit chips of the transistor-transistor-logic (TTL) variety. This qualifies the system as a minicomputer rather than a microcomputer. Even if an error was made in the chart, the system uses a 12-bit word that emulates the outdated PDP-8 minicomputer architecture. The MP12 must be excluded.

(b) Three of the remaining systems use an 8080A microprocessor, one uses the very similar 8085A, and 14 systems use the Z-80A. The latter is more modern and is generally regarded as far superior to the first two. Since there are so many Z-80A systems, there is no reason to further consider any 8080A or 8085A based systems.

(c) Five systems use other types of 8-bit microprocessors. One uses a 6800 while two others use the 6809, a more modern member of the same family. The 6800 system should be excluded. Another system uses the CDP 1802, a chip better adapted to special purpose controller use. This system (by Diversified Technology, Inc.) is probably used for development work rather than for general data processing, and it should be excluded. The remaining system uses the 6502 microprocessor. Millions of these chips have been sold, and many have been included in popular microcomputers of the "personal" variety such as the Apple and the six models by Ohio Scientific. The remaining 6502 system is the ETC-1000 by Electronic Tool Co., an organization which appears to be a custom configuration specialist. There is no reason to choose the 6502 when systems containing the Z-80A and the 6809 are available.

(d) The remaining seven systems use microprocessors with 16-bit words. Three of those systems are by Digital Equipment Corporation (DEC), and two more are by Plessey Microsystems using DEC computers. All five of these systems are variations of the same LSI-11 microcomputer. The LSI-11 qualifies in all respects as as candidate for selection as an MFT. It will be discussed further in Paragraph 3.4.7.

(e) The Data General MP/100 system also appears on the charts, and it could probably satisfy all of the requirements for an MFT. It has not been as widely distributed as the LSI-11, does not enjoy the same degree of software and maintenance support, and does not offer any advantages over the LSI-11. The remaining 16-bit machine is the Texas Instruments 9900/4 Home Computer that is not competitive in any way with the DEC and Data General machines. If compared with the 8-bit systems, it would be excluded because it dedicates 26K bytes of main memory to a ROM containing a BASIC interpreter. This fact is not evident from the Datapro charts.

3.4.6 Selection of 8-bit devices. Sixteen 8-bit systems remain. These contain two microprocessor chips, the Z-80A and the 6809. Nine vendors are represented, and the characteristics of the vendor now become of primary importance. The selection of a single vendor can be justified as follows:

3.4.6.1 Cromemco, Inc. This company is represented in the charts by four Z-80A based systems. It advertises frequently in many of the microcomputer-oriented publications. It publishes a complete catalog and maintains a network of dealers which now covers 42 states and 35 foreign countries. The Datapro charts indicate no deficiencies in any of the four systems that would remove them from consideration. The catalog shows that these systems have many additional qualities which would be advantageous in an MFT. This vendor is judged to be completely capable of supplying a satisfactory MFT test bed.

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3.4.6.2 Dynabyte, Inc. This company supplies two Z-80A based systems according to the charts. It advertises infrequently and apparently offers a line of equipment similar in many respects to that of Cromemco. Advertising is oriented toward business applications such as accounting and word processing. Probably an MFT could be assembled from Dynabyte products, but the company is evidently much smaller than Cromemco and has a very limited dealer structure.

3.4.6.3 Heurikon Corporation. This company offers two Z-80A based systems that appear to be satisfactory for use as an MFT except for the fact that they depend upon a cross-assembler rather than a resident assembler. No advertisements from this company have been located, so it seems likely that they are supplying a small localized market for a special purpose computer. There is nothing to be gained by selecting their product.

3.4.6.4 Infinite, Inc. This company offers one model that can be obtained with an 8080A, an 8085, or a Z80A chip. The company occasionally places small advertisements that suggest it is really in the business of supplying plug-in printed circuit boards to OEMs. At best, the product appears to be an intelligent terminal that does not provide many of the capabilities needed in an MFT.

3.4.6.5 North Star Computers, Inc. This company offers a Z-80A based system that is advertised widely and evidently is well accepted by users. Their impressive catalog displays a complete line of equipment including a hard disk drive capable of storing 18M bytes of information. The company advertises in the personal computer market and also in the small business market. Their products could doubtless meet most of the requirements for an MFT. The packaging of the equipment is definitely inferior to that of Cromemco for an industrial or tactical military environment. The dealer network appears to be smaller than Cromemco's, and the equipment design does not provide for some of the useful expansion options that are offered by Cromemco. Those options will be discussed in Paragraph 3.4.7.

3.4.6.6 Quay Corporation. This company offers three Z-80A based systems that have survived the preliminary selection processes. The company advertises in the personal computer publications but appears to be interested in selling to OEMs. It is attempting to offer low-priced competition to North Star. There is no evident reason to select the product of this company.

3.4.6.7 Radio Shack. This company offers the TRS-80 Model II, a Z-80A based system that appears to meet many of the requirements for an MFT. The system enjoys wide distribution and probably has better maintenance support than any other product in this group. It is intended primarily for business applications and does not have packaging that is sufficiently compact and rugged for air transport and for employment at the tactical air base. No mass storage other than multiple minifloppy diskettes is offered by the vendor. Expansion capability is very limited and is inadequate for use of this system as an MFT.

3.4.6.8 Southwest Technical Products Corporation. This company offers the only two systems in the charts that include the 6809 microprocessor. This is a more modern version of the 6800 chip and may justify the vendor's claim that it is the most powerful 8-bit microprocessor available today. The company advertises extensively in the personal computer market but is willing to sell to OEMs. Their catalog is less impressive than their advertisements. The company evidently has no dealer network and offers no maintenance support. Expansion capability is limited, and many peripheral devices are not supplied by the vendor although they could be obtained elsewhere. The attractive features of the 6809 are not sufficient to justify selection of a system from this company.

3.4.7 Conclusion. The selection process has singled out two systems that would be excellent choices for use as an MFT test bed. One CPU uses an 8-bit word while the other uses a 16-bit word. There is an undeniable advantage in the use of a 16-bit word, but the actual value of the advant   can only be judged subjectively in the context of the particu   lata processing application and with consideration of ot..r system characteristics. Many different criteria could be suggested for system comparison, but only two are believed to be necessary in this instance. These criteria are as follows:

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3.4.7.1 Flexibility of system configuration. The MFT
must serve any of several different elements of the TACS. These
elements have data processing needs that vary in degree and type
of service. It should be possible to alter the amount of mass
storage that is provided for programs and data. It should also
be possible to alter the number of input-output channels that
must be managed. Some applications will probably be identified
that require a graphic display capability, but these will
probably not require implementation at all elements of the TACS.
Some applications will require multiple video monitors, and some
may require an additional interactive user terminal. As
experimentation with the MFT progresses, it is to be expected
that requirements for the initial set of applications will be
expanded while entirely new applications will be suggested. In
general, the selected microcomputer system should be capable of
accepting a wide variety of peripheral device ports and
controllers. The vendor should provide most of the common
peripheral devices, and the system should be capable of
accepting plug-in modules produced by other vendors.

The Cromemco systems utilize the so-called S-100 bus which
provides standard interconnections for peripheral devices. The
electrical and mechanical configurations of this bus have been
approved by the Institute of Electrical and Electronic Engineers
(IEEE). For this reason, several system vendors have
incorporated the S-100 bus in their designs, and hundreds of
companies are offering for sale an ever-increasing number of
devices that are designed to plug into the bus. Cromemco
systems can accept a dozen or more optional plug-ins to
supplement those that comprise the basic system. The company
sells a broad line of plug-ins that can vary system
characteristics to fit practically any application. In
particular, Cromemco offers a plug-in I/O Processor that
contains a Z-80A microprocessor which can be programmed to work
concurrently with and under the control of the main CPU. This
product is believed to be unique in the industry at the present
time. It permits the design of an economical and efficient
multi-processor capability into a single integrated equipment
configuration. The main CPU and each of the auxiliary CPUs can
be fitted with independent read-only memory modules for programs
and random-access memory modules for data storage. All can be
given access to a single mass storage device through a very
effective direct memory access capability. The outstanding
flexibility of the Cromemco equipment makes possible the design
of MFT that takes full advantage of the newest microprocessor
technology.

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The three models of the DEC LSI-11 microprocessor are available in a variety of complete systems including the PDP-11/03 by DEC. Several other vendors also offer systems that combine some DEC equipment with the products of other manufacturers. The Datapro report mentioned only one of these vendors, Plessey Microsystems. Many manufacturers also offer plug-in devices that can be accepted by the DEC bus. This is such a large market that the January 1981 issue of "Digital Design" magazine featured an article entitled "The DEC Compatible World". The article lists scores of products that are marketed to take advantage of the wide popularity of the LSI-11. The list is probably as large as the list of S-100 bus suppliers and may include many of the same names. Despite this broad support, the LSI-11 is believed to be a poorer choice than a Cromemco system for the following reasons:

(a)   DEC does not offer all types of peripheral devices for its own systems, and no other vendor is known that can supply a complete selection. DEC is so large that is must move slowly in offering new devices such as Winchester disks that represent the latest technology. Other manufacturers may temporarily supply the new devices but move on to other markets when DEC finally makes a selection. Assembling an MFT around on LSI-11 would probably require dealing with several vendors.

(b)   The backplane supplied by DEC for the LSI-11 offers less expansion capability than the Cromemco system. There appears to be no plug-in module that is equivalent to the Cromemco I/O Processor. To produce an MFT with a multi-processing capability, it would be necessary to add a complete PDP-11/03 for each additional processor. Interconnections would be more difficult and less efficient since the CPUs could not share the same bus. Shared use of a single mass storage disk would be virtually impossible.

(c)   Although comparison is difficult, the cost of an MFT built from DEC-compatible equipment appears to be about twice the cost of a similar configuration from Cromemco. The cost of a second CPU from DEC would be about five times the cost of the equivalent I/O processor card from Cromemco. Standard system software from DEC costs about three times as much as a set of similar packages from Cromemco. Weight, power consumption, and total displaced volume of equipment appear to be similar.

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3.4.7.2 Growth capability. To serve effectively as a
test bed for determining TAF requirements, the MFT must be
capable of controlled modification to accept new devices and
techniques of operation. Applications that are developed on the
MFT must be transferable to different equipment configurations
with a minimum of difficulty. Applications must also be
transferable to systems offered by different vendors to reap the
benefits of competition if a large number of MFT-like systems
are to be procured. All of these benefits are made available to
the computer purchaser for the first time by the choice of a
microcomputer based system. Ther magnitude of the benefits
depends upon the choice of microprocessor.

The 8080 microprocessor was introduced in 1973 and has
become the most widely used computer in history. In 1976, the
Z-80A was introduced. It was compatible with 8080A programs but
offered substantial improvements. In 1979, the Z8000 became
available and offered an even greater degree of improvement over
the Z-80A. The Z8000 is a 16-bit machine that is comparable in
power to mainframes such as the IBM 360/370 series and to the
largest of the minicomputers such as the DEC PDP-11/70. No
off-the-shelf systems yet use the Z8000, but when they are
available, Z-80A programs can be translated to run on them.
Meanwhile a very large number of peripheral devices have been
developed using support chips compatible with the 8080A and the
Z-80A. The great majority of these devices connect to the S-100
bus. In choosing to build systems around the Z-80A chip and the
S-100 bus, Cromemco has probably offered its customers the
greatest possible capacity for growth.

The DEC LSI-11 microcomputer uses the MCP-1600 chip set
which can be microprogrammed to emulate many different 8- and
16-bit computers including the DEC PDP-11/34 minicomputer. The
chip set is available to OEMs, but only one, Alpha Microsystems,
is known to market a system based upon it. The MCP-1600 is more
powerful than the 8-bit Z-80A and may be equivalent to the Z8000
in capability. It now has a great many users and is usually
microcoded to be compatible with the whole DEC PDP-11 family of
mincomputers, so it is not likely to be replaced for many years.
As previously mentioned, a great many vendors offer
DEC-compatible equipment that often is at the forefront of the
technology. DEC itself can be said to offer a system with
excellent current capability but with limited possibilities for
growth through the exploitation of new technology.

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3.4.7.3 Recommendation. The equipment offered by Cromemco Incorporated is the most responsive to the general selection criteria stated in Paragraph 3.1.2.2. A detailed configuration of this equipment will be described in Paragraph 5 after the functional and operational requirements have been established.

4.   MFT FUNCTIONAL TASK REQUIREMENTS

4.1 <u>Approach</u>. The methodology used to determine the functional requirements for each of the 15 command and control tasks as described in Paragraph 2.4 and is based upon two primary factors. These are:

(a) The type and volume of data elements found in formatted data exchange messages.
(b) The internal processing and display of that data to provide maximum user assistance in completing designated command and control tasks at the WOC level only.

The functional requirements for each are stated in user terms and will reflect what the data processing functions must provide to the user. No attempt is made to specify the exact internal data processing programs that accomplish the user requirements.

4.2 <u>Mission Control Task Requirements</u>

4.2.1 Mission request processing. The requirements of this task are to provide the user with an ability to input user-determined mission request data, visually review individual mission request data in a user-defined format and visually review current status displays of all mission request data files.

4.2.2 Mission plan processing. The requirements of this task are to provide the user with the ability to separately implement each of the specific program routines associated with the detailed mission planning of an individual tasked mission and view the results of each routine in graphic display if applicable. Examples of routines for individual tasked mission include:

(a) Availability and capability of specific weapon systems to perform the mission.
(b) Weapon system delivery tactics.
(c) Standard route profiles.
(d) Threat assessment.
(e) Terrain effect on mission.
(f) Target material requirements.
(g) Safe area location.

The crew products required from the accomplishment of this task are:

    (a)   The Pilots Flight Plan and Flight Log (similar to AF Form 70).

    (b)   A mission strip flimsy in graphic form depicting key enroute locations, threats, safe areas, and targets.

    (c)   Specific target materials as required.

4.2.3 Mission tasking processing. The requirements of this task are to provide the user with all data applicable to individual tasked missions provided in the Air Tasking Order. The user must have the ability to view the data in several user defined sorts and allocate specific aircraft and aircrews to each mission.

4.2.4. Mission monitoring processing. The requirements of this task are to provide the user with the ability to input user-determined mission debrief data, visually review individual mission debrief data in a user-defined format and visually review current status displays of all mission debrief data files.

4.3 Current Information Task Requirements

4.3.1 Resource availability processing. The requirements of this task are to provide the user with the ability to input user-determined resource availability data, to visually review all resource availability data by type of resource, and to visually review current status displays of all resource availability data files by resource type in user defined formats.

4.3.2 Friendly force disposition processing. The requirement of this task is to provide the user with a graphic display of friendly force locations by type and geographic area as defined by the user.

4.3.3 Enemy force disposition processing. The requirement of this task is to provide the user with a graphic display of enemy force locations by type and geographic area as defined by the user.

4.3.4 Weather processing. The requirement of this task is to provide the user with a graphic display of weather data by type and geographic area as defined by the user.

4.4 Background Information Task Requirements

4.4.1 Resource capabilities processing. The requirement of this task is to provide the user with a display of capability data by weapon system type. This task uses data that changes infrequently. The user must have a data update capability.

4.4.2. Terrain description processing. The requirement of this task is to provide the user with a graphic display of user selected terrain data by terrain type and geographic area as defined by the user.

4.4.3 Friendly force capabilities processing. The requirement of this task is to provide the user with a display of friendly force weapon systems capabilities by weapon type.

4.4.4 Enemy force capabilities processing. The requirement of this task is to provide the user with a display of enemy force weapon systems capabilities by weapon type.

4.5 Information Analysis Task Requirements

4.5.1 Threat assessment processing. The user graphic display requirement of this task is directly related to routines in the mission planning requirement.

4.5.2 Target nomination processing. The requirement of this task is to provide the user with a graphic display of individual target data in several user-defined sorts such as target type, target location, target priority, etc. This task is directly related to the mission request, mission plan and mission tasking requirements.

4.5.3 Penetration analysis processing. The user graphic display requirement of this task is directly related to routines in the mission planning requirement.

4.6 MFT Modular Structure. In the tactical environment
there is a demanding need to perform basic independent tasks
simultaneously and with a maximum of speed and efficiency. Many
of these tasks are repetitive and cyclic. They can be easily
grouped into three major categories. One group deals with the
receipt and dissemination of data in a prescribed data format
and communications protocol. A second group performs data file
storage, update and retrieval functions as well as specific
applications programs. The third group handles all functions
related to data display and user interaction with the computer
system.

Based upon this grouping of functional tasks, a modular
configured design would include a Communications Subsystem, a
Storage and Retrieval Subsystem, and a Display Subsystem. Each
subsystem must have the independent and simultaneous ability to
perform its assigned tasks, and pass the results of those tasks
to another subsystem, as necessary, without interruption. Each
subsystem must be self-contained, must have high reliability,
must have the flexibility to accommodate new technology
capabilities, and must be maintainable by non-technicians. The
subsystems must interface physically and electrically with
minimum complexity to form a total system. The total system
must have the ability to be easily tailored or reconfigured to
meet a variety of physical and operational combat environments.

4.7 Communication. It has been shown in Paragraph 3 that
many of the 15 command and control tasks depend upon the flow of
information between components of the TACS and also of the JTF.
A principal requirement for the MFT is that it be capable of
supporting this flow of information at any of the component
units. The dimensions of the requirement depend upon the number
of message types to be recognized, the number of functional
tasks to be supported by the MFT, and the amount of message
traffic generated by each task.

4.7.1 Message types. It has been mentioned that JINTACCS
message formats soon will be used by all of the armed services
and allied nations. The formats associated with each command
and control task have been listed in Tables 1 through 10. These
formats fall into four categories, as follows:

(a) Data messages. These contain information that could be
placed in computer files and recalled in one form or
another to support one or more of the command and
control tasks. These form the principal load on the
MFT.

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(b)   Transfer messages. These messages contain summary
      type free-text information that must be generated by
      humans rather than by computer programs. The MFT
      would usually be expected to assist in the
      preparation of these messages, to transmit them, and
      to receive them.

(c)   Control messages. These messages are exchanged by
      voice radio between ground stations and aircraft or
      other mobile ground stations. They report current
      status or provide in-flight control. They are seldom
      written and will not appear in digital form so will
      not be processed by any MFT.

Table 11 lists in alphanumeric order all 144 of the JINTACCS
formats that could be used within the TACS. These formats are
assigned to one of the four groups described above.

4.7.2   Data messages. Table 12 shows the 68 data messages
that were designated in Table 11. Additional information about
them is given as follows:

(a)   LEN. This column gives the estimated average length in
      characters of messages in each format. These figures
      cannot be exact because the JINTACCS specifications
      provide for wide latitude in the structure of most
      formats. They are intended to support a first
      approximation of message traffic volume.

(b)   IN. This column shows the estimated number of such
      messages that will arrive at a WOC in a 24-hour
      period under typical tactical conditions.

(c)   OUT. This column shows the estimated number of such
      messages to leave a WOC in a 24-hour period. The
      IN/OUT estimates are based upon first hand experience
      with equivalent message types, but they are still
      only rough approximations.

(d)   PBH. This shows the clock time of the peak busy hour
      of the day for messages of this type. This value
      appears to have little significance.

4.7.3   Transfer messages. Table 13 shows the 23 transfer
messages that were identified in Table 11. The same type of
estimates are shown for these formats. It seems reasonable to
conclude that the communication channel traffic generated by
these messages will not produce a significant load on the
system. There will, however, be a need for the MFT to store
these formats and to provide programmed checks.

4.7.4 Component versus application. The various components of the TACS have specialized duties so that not all of them participate in all of the command and control tasks. Table 14 shows columns for each of the eight applications that require the exchange of data and transfer messages. A row is provided for each of the TACS components described in Paragraph 2. An X at the junction indicates that the component participates to some degree in that application. The table suggests that it may be advisable to vary the MFT hardware and software at different components to minimize cost, space problems, and training requirements. Like all of the other tables, this table is open to considerable discussion. It illustrates the type of information that should be sought by experimentation.
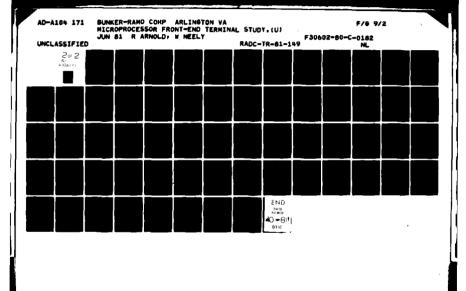
TABLE 11
JINTACCS MESSAGE SUMMARY

MESSAGE		DATA	TRANS	TACC	CTRL
A100	TARBUL	X			
A210	FMC			X	
A260	FSC	X			
A421	EXORD		X		
A422	FRAGORDER	X			
A425	ERTM	X			
A440	WARNORD		X		
A635	HELOALDAT	X			
A650	APORALOT			X	
A651	EMPLOYALOC			X	
A652	SORTALOT			X	
A653	CROSSDAT	X			
A661	REQSTSTSK	X			
A690	TACOPDAT	X			
A691	TECHOPDAT	X			
A770	ALORD	X			
A900	ADSCRAMORD	X			
A901	SARSCRAMORD	X			
A902	TNKSCRAMORD	X			
A903	CASSCRAMORD	X			
B260	FRD	X			
B702	JLNCHREP	X			
B703	AIREVENT	X			
B704	ABCHANGE	X			
B705	ACSAMSTAT	X			
B711	ENGSTS				X
B750	JINFLT				X
B900	TACOPLINEUP	X			
B901	UNITSTATREP	X			
B902	FCLTYSTATREP	X			
B903	RESUSTATREP	X			
B904	CNTRLCAPREP			X	
B905	ALCESTATREP	X			
B906	CCTSTATREP			X	
B907	ARPSTATREP	X			

TABLE 11 (cont.)
JINTACCS MESSAGE SUMMARY

MESSAGE		DATA	TRANS	TACC	CTRL
B908	CASALSTATREP	X			
B909	TACMUSTATREP	X			
B910	AIRDEFFTRSTAT	X			
B911	SAMSTATREP			X	
C001	MSGCHANGEREP	X			
C100	IPIR	X			
C101	SUPIR			X	
C102	MIPIR			X	
C110	INTREP	X			
C111	TACREP			X	
C112	TGTINFOREP	X			
C113	HOTPHOTOREP	X			
C120	MIJIFEEDER	X			
C121	TACELINT	X			
C130	MISREP	X			
C131	SENREP			X	
C240	FMR	X			
C400	SITREP		X		
C420	SARSIT			X	
C440	RPTMINEOPS	X			
C441	NBC4		X		
C442	NBC3		X		
C444	NBC5		X		
C451	VULWARN			X	
C460	COMSPOT	X			
C482	SARIR				X
C485	NBC1		X		
C486	OPREP-3P		X		
C487	OPREP-3		X		
C490	OPREP-3PNF		X		
C491	OPREP-3PFB		X		
C492	OPREP-3PED		X		
C493	OPREP-3PEV		X		
C494	OPREP-3PBA		X		
C495	OPREP-3BS		X		

TABLE 11 (cont.)
JINTACCS MESSAGE SUMMARY

MESSAGE		DATA	TRANS	TACC	CTRL
C496	OPREP-3FG		X		
C520	SEVERE STORM	X			
C521	WXFCST	X			
C522	WXRPT	X			
C523	PTWXWARN	X			
C900	TAKEOFFREP	X			
C901	LANDINGREP	X			
C902	ABORTREP				X
C903	TNKINFLTREP				X
C904	AIRDELAYREP				X
C905	GNDDELAYREP				X
C906	DISTRESSREP				X
C907	DOWNEDPIREP				X
C908	ARRIVALREP	X			
C909	DEPARTUREREP	X			
C910	ADVISORYREP	X			
C913	CGOEXCREP		X		
C914	INIATIALREP				X
C915	UPDATEREP				X
C916	CORECMREP				X
C917	UNCORECMREP				X
C918	ECMTERMREP				X
C919	ORBITREP				X
C920	SPLITTRKREP				X
C921	MERGTRKREP				X
C922	MASSTRKREP				X
C923	IFFEMERGREP				X
C924	CONTACLSTREP				X
C925	EMERGREP				X
C926	TACACTIONREP				X
C927	OFFACTIONREP				X
C928	WEACOMITREP				X
C929	ECTARREP	X			
D100	JTACARSREQ	X			
D110	RII	X			

TABLE 11 (cont.)
JINTACCS MESSAGE SUMMARY

	MESSAGE	DATA	TRANS	TACC	CTRL
D111	RRII	X			
D120	JRSRR			X	
D200	JCASINTREQ	X			
D260	RFR	X			
D630	ALREQ	X			
D634	HELOALREQ	X			
D660	JAIRREQ	X			
D666	JESCREQ	X			
D667	JRECREQ	X			
D668	JSUPREQ	X			
E400	OPLANCHG		X		
E402	EWAM			X	
E445	STRIKEWARN		X		
E706	INITHAND				X
E707	RECHAND				X
E710	ARDEFCOM		X		
E715	AIRDEFWARN				X
E900	MSNACFTMSG				X
E901	MSNCNTRLMSG				X
F260	RRM	X			
F401	EWEM			X	
F541	AKNLDG		X		
F542	RETRANS		X		
F625	REQCONF	X			
F631	ALMSNSCD	X			
F632	FLTCONTINFO				X
F636	HELOALCONF	X			
F654	CROSSCONF	X			
F750	DESIGAREA	X			
F751	ECMDAT				X
F752	TRKMAN				X
F753	TRKREP				X
F754	FLTPLN				X
F755	TRKINTEL				X
G130	DISUM	X			

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TABLE 11 (cont.)
JINTACCS MESSAGE SUMMARY

MESSAGE		DATA	TRANS	TACC	CTRL
G131	INTSUM	X			
G423	OPSUM			X	
G424	EWMSNSUM	X			
G480	NBC2		X		

TABLE 12
DATA MESSAGE SUMMARY

DATA	MESSAGE	LEN	IN	OUT	PBH	APPLICATION
A100	TARBUL	400	18	0	2200	EDIS
A260	FSC	800	4	0	0500	FDIS
A422	FRAGORDER	1500	2	0	-	MPLAN,MTASK
A425	ERTM	900	4	0	2400	MREQ,MTASK,EDIS
A635	HELOALDAT	2500	2	0	2400	MTASK
A653	CROSSDAT	12500	4	0	2400	MTASK
A661	REQSTSTSK	6000	4	0	2400	MREQ,MPLAN,MTASK
A690	TACOPDAT	3000	1	0	-	MPLAN,FDIS
A691	TECHOPDAT	3000	1	0	-	MPLAN
A770	ALORD	500	10	0	-	MTASK
A900	ADSCRAMORD	600	20	0	-	MTASK
A901	SARSCRAMORD	600	5	0	-	MTASK
A902	TNKSCRAMORD	600	3	0	-	MTASK
A903	CASSCRAMORD	900	15	0	-	MTASK
B260	FRD	700	18	0	-	FDIS
B702	JLNCHREP	600	0	15	-	MREQ,MTASK
B703	AIREVENT	900	0	72	-	MMON,EDIS
B704	ABCHANGE	1400	0	4	-	RESOR
B705	ACSAMSTAT	800	0	8	-	RESOR
B900	TACOPLINEUP	1400	0	1	-	RESOR
B901	UNITSTATREP	1000	0	3	0,8,1	RESOR
B902	FCLTYSTATREP	600	0	3	-	RESOR
B903	RESUSTATREP	600	0	2	-	RESOR
B905	ALCESTATREP	800	0	3	-	RESOR
B907	ARPSTATREP	1400	0	3	-	RESOR
B908	CASALSTATREP	700	0	2	6,12	RESOR
B909	TACMUSTATREP	1400	0	2	6,12	RESOR
B910	AIRDEFFTRSTA	400	0	4	-	RESOR
C001	MSGCHANGEREP	-	-	-	-	ALL
C100	IPIR	1300	20	0	-	EDIS
C110	INTREP	500	35	5	-	EDIS
C112	TGTINFOREP	600	10	0	-	EDIS
C113	HOTPHOTOREP	750	20	0	-	EDIS
C120	MIJIFEEDER	600	6	6	-	EDIS
C121	TACELINT	800	12	0	-	EDIS

TABLE 12 (cont.)
DATA MESSAGE SUMMARY

DATA	MESSAGE	LEN	IN	OUT	PBH	APPLICATION
C130	MISREP	700	72	72	–	EDIS
C240	FMR	500	15	0	–	MMON,EDIS
C440	RPTMINEOPS	600	2	0	–	FDIS,MPLAN
C460	COMSPOT	600	3	0	–	RESOR
C520	SEVERE STORM	700	3	0	–	WETHR
C521	WXFCST	1000	4	0	–	WETHR
C522	WXRPT	600	12	0	–	WETHR
C523	PTWXWARN	400	3	0	–	WETHR
C900	TAKEOFFREP	300	0	72	–	MMON
C901	LANDINGREP	300	0	72	–	MMON
C908	ARRIVALREP	400	0	15	–	MMON
C909	DEPARTUREREP	400	0	15	–	MMON
C910	ADVISORYREP	400	0	5	–	MMON
C929	ECTARREP	500	0	20	–	MMON,RESOR,EDIS
D100	JTACARSREQ	700	30	10	–	MREQ
D110	RII	600	0	15	–	EDIS
D111	RRII	2000	5	0	–	EDIS
D200	JCASINTREQ	800	15	0	–	MREQ,MPLAN
D260	RFR	600	10.	0	–	MPLAN
D630	ALREQ	900	8	0	–	MREQ,MPLAN
D634	HELOALREQ	900	4	0	–	MREQ,MPLAN
D660	JAIRREQ	1100	15	3	–	MREQ,MPLAN
D666	JESCREQ	700	15	5	–	MREQ,MPLAN
D667	JRECREQ	700	30	10	–	MREQ,EDIS
D668	JSUPREQ	500	10	5	–	MREQ,MPLAN
F260	RRM	–	–	–	–	ALL
F625	REQCONF	–	–	–	–	MREQ,MPLAN
F631	ALMSNSCD	1100	0	2	5,11	MREQ,MPLAN
F636	HELOALCONF	1100	0	2	3,9	MREQ,MPLAN
F654	CROSSCONF	6000	0	4	0300	MREQ,MPLAN,MTASK
F750	DESIGAREA	800	4	0	–	MPLAN,FDIS
G131	INTSUM	4000	4	4	6 hrs	EDIS
G424	EWMSNSUM	2000	0	30	–	MPLAN,RESOR,EDIS

TABLE 13
TRANSFER MESSAGE SUMMARY

TRANSFER MESSAGE		LEN	IN	OUT	PBH	APPLICATION
A421	EXORD	400	2	0	–	MPLAN,MTASK
A440	WARNORD	600	10	0	–	MPLAN,MTASK
C400	SITREP	1500	0	2	–	MPLAN,FDIS
C441	NBC4	400	0	1	–	FDIS
C442	NBC3	600	1	0	–	FDIS
C444	NBC5	600	0	1	–	FDIS
C485	NBC1	500	0	1	–	EDIS
C486	OPREP-3P	600	0	2	–	EDIS
C487	OPREP-3	600	0	4	–	EDIS
C490	OPREP-3PNF	500	0	1	–	RESOR
C491	OPREP-3PFB	700	0	3	–	RESOR
C492	OPREP-3PED	600	0	1	–	RESOR
C493	OPREP-3PEV	600	0	1	–	RESOR
C494	OPREP-3PBA	600	0	1	–	RESOR
C495	OPREP-3BS	600	0	1	–	RESOR
C496	OPREP-3FG	600	0	1	–	RESOR
C913	CGOEXREP	1000	1	1	–	MMON
E400	OPLANCHG	900	1	0	–	MPLAN,MTASK
E445	STRIKEWARN	500	3	0	–	MPLAN
F541	AKNLDG	–	–	–	–	ALL
F542	RETRANS	–	–	–	–	ALL
G130	DISUM	2000	1	0	–	EDIS
G480	NBC2	600	0	1	–	EDIS

TABLE 14
COMPONENT VERSUS APPLICATION

TACS COMPONENT	MREQ	MPLAN	MTASK	MMON	RESOR	FDIS	EDIS	WETHR
TACC	X	X	X	X	X	X	X	X
WOC	X	X	X	X	X	X	X	X
SQDRN	–	X	X	–	X	X	X	X
CRC	–	–	–	X	–	–	–	X
CRP	–	–	–	X	–	–	–	X
ASOC	X	X	X	X	X	X	X	X
ALCC	X	X	X	X	X	–	–	X
ALCE (WOC)	X	X	X	X	X	X	X	X
ABCCC	–	–	X	X	X	X	X	X
AWACS	–	–	X	X	X	X	X	X
FACP	–	–	–	X	–	–	–	X
ASRT	–	–	X	X	–	–	–	X
TACP	–	–	X	X	–	–	X	X
EXTERNAL	X	–	–	–	X	X	X	–

5. CONCLUSIONS AND RECOMMENDATIONS.

5.1 <u>Conclusions</u>. The requirements for the MFT equipment may be summarized as follows:

5.1.1 Physical requirements. These are implied by the fact that the MFT must function at a tactical air base.

(a) The equipment shall operate satisfactorily without conditioned air and without any external protection from dust and dirt.

(b) The equipment shall operate with the electrical power available from a field generator shared with other services. It should not require more than 500 watts.

(c) The equipment shall be capable of being mounted semi-permanently in a standard transportable shelter such as the Air Force Quick Reaction Package (QRP). Mounting in a regulation 19 inch steel equipment rack is preferred.

(d) The equipment shall be capable of withstanding the shock and vibration associated with air transport. It need not operate during transport.

(e) The equipment shall be small enough in weight and volume to be relocatable by two men without special tools. A gross weight of less than 200 pounds is desirable.

5.1.2 Operational requirements.

(a) The equipment shall include at least four serial communication ports that are electrically compatible with standard military communication equipment. Conformity with MIL-188-C is desired, but use of the RS-232 standard is acceptable. The equipment shall be capable of providing a synchronizing signal for cryptographic equipment.

(b) The equipment and the programs shall not require the presence of specially trained computer operators, maintenance programmers, or computer technicians. The system shall be operable by personnel who use it to assist in the performance of their normal tactical duties.

(c) An alphanumeric terminal shall be provided that
     includes a keyboard sealed from the effects of dust
     and moisture. It shall also include a monochrome
     cathode ray tube display with a diagonal measurement
     of at least 12 and not more than 17 inches. From
     eight to 16 programmable function keys shall be
     included.

(d) The principal mass storage medium shall be a Winchester
     disk with a capacity of at least 10 million bytes.
     Two floppy disk drives shall be available for
     optional use in some applications and for program
     development. Five inch, double density, single or
     double sided diskettes are preferred. The system
     shall be capable of modification to accept other mass
     storage media, such as bubble memory, when they
     become available.

(e) The system shall include a dot matrix impact printer
     with a carriage width of 132 columns. The printer
     shall print from 60 to 200 characters per second and
     shall provide tractor feed of standard fan-fold
     paper.

(f) The central processing unit (CPU) shall contain at
     least one microprocessor with a word length of 8 or
     16 bits. The use of multiple microprocessors in a
     multiprocessor configuration is strongly
     recommended.

(g) The CPU shall contain at least 64K bytes of
     semiconductor memory as the main data and program
     storage. The optional capability to store and use
     programs in programmable read-only memory (PROM)
     shall also be provided.

(h) The system shall include the optional capability to
     drive from one to four remotely located video
     monitors for the presentation of key-selectable
     tabular data displays. The monitors shall contain
     monochrome cathode ray tube displays with a diagonal
     measurement of not less than 19 inches.

(i) The system shall provide for the optional addition of a
     graphic display terminal of the raster scan type for
     optional later development. It should also be
     possible to add color graphics at a later date.

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5.2 Recommendation. A test bed that permits development,
testing, and demonstration of applications programs for an MFT
can be created with off-the-shelf equipment available from
Cromemco, Incorporated. A list of equipment items recommended
for the initial installation is shown in Table 15. This
equipment provides the two computer systems illustrated in
Figures 12 and 13. The standard configuration in Figure 12
includes the three recommended subsystems in a multiprocessor
arrangement. This configuration would satisfy the requirements
of a WOC, in particular. The minimum MFT configuration shown in
Figure 13 would be usable at one of the less demanding TACS
components, such as the CRC. Together, they permit the use of
actual or simulated communication channels in program
development and in system demonstration.

TABLE 15

RECOMMENDED MFT DEVELOPMENT SYSTEM

1 Cromemco Z-2H Hard Disk Storage Computer System.
        Including 1 11-megabyte hard disk drive
                 2 floppy disk drives
                 64K main storage

1 Cromemco System Two Disk Computer.
        Including 2 floppy disk drives
                 64K main storage

2 CRT Terminals, Model 3102

1 Line Printer, Model 3703

1 Programmable Read Only Memory Board, Model 8KBS
        Providing 8K bytes of PROM
                 1 PROM programmer

2 Programmable Read Only Memory Boards, Model 16KPR
        Providing 16K bytes of PROM

3 I/O Processor Boards, Model IOP
        Including Z-80A microprocessor
                 16K bytes of random storage
                 16K bytes of PROM capacity

3 Serial Communication Interface Boards, Model QDRT

1 Fifteen Inch Video Monitor, SANYO Model 4215
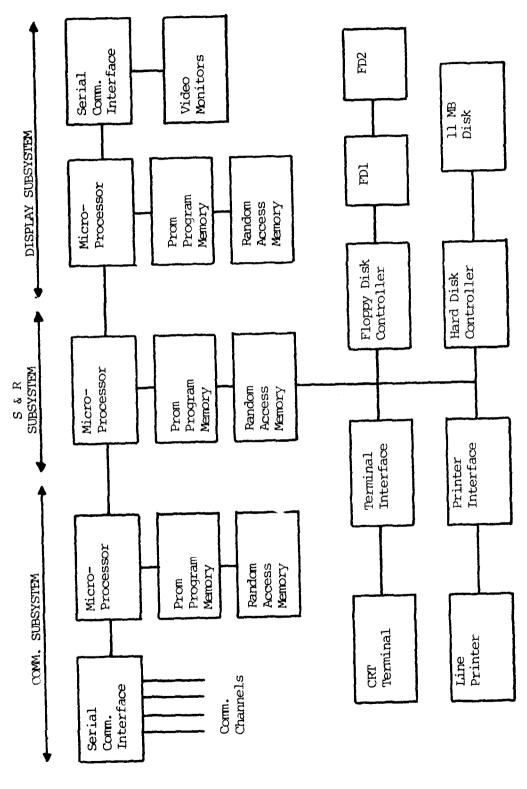
Figure 12: Standard MFT Equipment Configuration
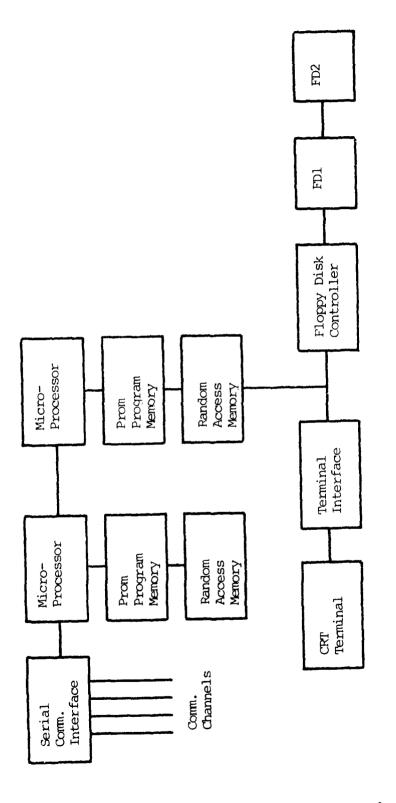
Figure 13: Minimum MFT Equipment Configuration

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APPENDIX A
REFERENCES

1. TAF ORGANIZATION REFERENCES.

(a) "TACR 55-45, Tactical Air Force Headquarters and the
     Tactical Air Control Center", Draft, January 1980.
(b) "TAC CONPLAN 61 - TAC Standard Communications Plan",
     January 1980 (FOUO).
(c) "Tactical Air Forces Integrated Information System
     (TAFIIS) Master Plan", September 1980 (SECRET)
(d) "Tactical Unit Operations Center Functions/Information
     Flow", 1 October 1979, USAF Tactical Air Warfare
     Center, Eglin Air Force Base, Florida.
(e) "Operational Automated Penetration Analysis/Mission
     Planning Capability Users Conference Minutes", 8-11
     January 1980, HQ TAC, DCS/Operations for Control and
     Support.
(f) "Tactical Air Force Integrated Information System
     (TAFIIS) Master Plan (U)", Volumes 1 through 8,
     September 1980, TAFIG/IIAC, Langley AFB, Va.
(g) "JINTACCS Technical Interface Design Plan (Test
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     DAAC-JI (CONF).
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     Edition)", Volume VI, Air Operations (U), August
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(i) "JINTACCS Message Standards Catalog of Keyword Data
     Sets", Draft 7, 5 Feb 1979; Change 1, April 1979.
(j) "JINTACCS Message Element Dictionary", Parts I, II, and
     III with CONFIDENTIAL Supplement.
(k) "JINTACCS Technical Interface Concepts (U)", Second
     Draft, May 1977, DAAC-JI, (CONF).
(l) "JINTACCS Technical Interface Design Plan, (Test
     Edition)", Appendix D: "Terms and Definitions",
     Fourth Draft, 3 May 1979, DAAC-JI.
(m) "JINTACCS Technical Interface Design Plan", Appendix E:
     "Character-Oriented Message Text Formatting Rules",
     Update 3, 15 July 1979, DAAC-JI.
(n) "JINTACCS Technical Interface Design Plan, (Test
     Edition)", Appendix H: "Data and Communications (U)",
     Working Draft 5, 11 January 1980 (CONF).

2. MICROCOMPUTER REFERENCES.

(a) "An Introduction to Microcomputers", Volumes 1 through
     3, September 1978, with updates to August 1979,
     Osborne and Associates, Inc., Berkeley, CA
(b) "All About Microcomputers", June 1980, Datapro Research
     Corporation, Delran, NJ
(c) "All About Personal Computers", May 1980, Datapro.
(d) "All About Small Business Computers", Jan 1980,
     Datapro.
(e) "All About Communications Processors", May 1980,
     Datapro.
(f) "Microprocessor Specifications", May 1980, Datapro.
(g) "All About User-Programmable Terminals", Nov 1979,
     Datapro.
(h) "All About Graphic Display Devices", May 1980,
     Datapro.
(i) "All About Facsimile Devices", May 1980, Datapro.
(j) "All About Computer Printers", May 1980, Datapro.

3. PERIODICAL REFERENCES.

(a) "Computer Design", Pennwell Publishing Co., Winchester,
     MA.
(b) "Electronic Design", Hayden Publishing Company, Inc.,
     Rochelle Park, NJ.
(c) "Digital Design", Benwill Publishing Corp., Boston,
     MA.
(d) "EDN", Cahners Publishing Company, Boston, MA.
(e) "Computer Decisions", Hayden Publishing Company, Inc.
(f) "Infosystems", Hitchcock Publishing Company, Wheaton,
     IL.
(g) "Mini-Micro Systems", Cahners Publishing Company
(h) "Small Business Computers", SBC Publishing Company,
     Inc., Montclair, NJ.
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     Garden City, NY.
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     and Electronics Association", Falls Church, VA.
(l) "Computerworld", CW Communications, Inc., Framingham,
     MA.
(m) "Creative Computing", Creative Computing, Morristown,
     NJ.
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     CA.

APPENDIX B
JINTACCS SUMMARY

1. INTRODUCTION

1.1 Purpose. The purpose of this appendix is to provide
sufficient background information to enable the reader to
understand the JINTACCS approach to message format design as it
applies to the data messages to be used for the TACS command and
control tasks. Examples of the message formats themselves are
described completely in Appendix C to this final technical
report.

1.2 JINTACCS Concepts. The Joint Interoperability of
Tactical Command and Control Systems (JINTACCS) program is
sponsored by the Department of the Army, Office of the Assistant
Chief of Staff for Automation and Communications (DAAC-JI). Its
purpose is to standardize the formats and language of
electrically transmitted messages used by USAF, ARMY, NAVY,
USMC, NSA and DIA. Several hundred message formats have been
developed and described in voluminous documentation. In the
Intelligence area, at least, many of the formats have been
tested and demonstrated but none are in actual use. JINTACCS
formats should be implemented in the design of the MFT
application programs whenever possible. To supplement these
formats, existing message formats could be used or JINTACCS -
compatible formats could be devised. The underlying concepts
for message format design are given in various references and
are restated as follows:

   (a) To design messages containing sufficient plain language
        content to make them understandable by humans,
        together with sufficient structuring to make them
        easily processed by computers.
   (b) To achieve the widest utilization of message formats by
        making them acceptable to teletypewriter terminals.
   (c) To provide formatting only for the textual portions of
        messages. The communications header portions will
        continue to be specified in Joint Army, Navy, Air
        Force Publication (JANAP) 128, current edition;
        Allied Communications Publications (ACP) 126 and 127,
        current editions; and appropriate US and NATO
        supplements thereto.

(d) To reduce the time and effort involved in the drafting, transmission, analysis, interpreting, and processing of messages used by command and control systems in all defense conditions from peactime to general war.

(e) To facilitate the exchange of information between US and NATO authorities.

1.3 References. The list of JINTACCS documentation for all purposes is very large and is continually increasing. Most of these documents have not been reviewed during the preparation of this report. Those listed below have been used and are believed to be adequate for designing many if not all of the MFT application programs.

(a) JINTACCS Technical Interface Design Plan (Test Edition), Volume II, Intelligence (U), April 1979 DAAC-JI (CONF).

(b) JINTACCS Technical Interface Design Plan (Test Edition), Volume VI, Air Operations (U), August 1979, DAAC-JI (CONF).

(c) JINTACCS Message Standards Catalog of Keyword Data Sets, Draft 7, 5 Feb 1979; Change 1, April 1979.

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(f) JINTACCS Technical Interface Design Plan, (Test Edition), Appendix D: Terms and Definitions, Fourth Draft, 3 May 1979, DAAC-JI.

(g) JINTACCS Technical Interface Design Plan, Appendix E: Character-Oriented Message Text Formatting Rules, Update 3, 15 July 1979, DAAC-JI.

(h) JINTACCS Technical Interface Design Plan, (Test Edition), Appendix H: Data and Communications (U), Working Draft 5, 11 January 1980 (CONF).

2. JINTACCS MESSAGE IDENTIFICATION

2.1 <u>Message Types</u>. JINTACCS messages are either character-oriented messages (COM) or bit-oriented messages (BOM). The former are structured in a keyword format using alphanumeric characters suitable for both human and machine use. The latter are structured in binary digits and are therefore restricted to machine interpretation. The Microprocessor Front-End Terminal (MFT) is intended for interactive use by humans and it will therefore process no BOMs. The structure of COMs is described in the document named at item (g) of the preceding paragraph. The provisions of this document are summarized in the following paragraphs.

2.2 <u>Message Identifiers</u>. An alphanumeric identifier is assigned to each JINTACCS message format. The identifier is composed of an initial letter followed by a three digit number.

    (a)   The initial letter indicates the purpose of the message as shown in the following table:

        A. Orders And Directives
        B. Status
        C. Reports
        D. Planning and Support Requests
        E. Force and Weapon Control
        F. Information Exchange
        G. Summary
        H. Spare
        M. Bit-Oriented Messages

    (b)   The three digit number indicates the functional group as shown in the following table:

        001-099: Common Messages
        100-199: Intelligence
        200-299: Fire Support
        300-399: Amphibious
        400-599: Operations Control
        600-799: Air Operations
        800-899: Spare
        900-999: TAF Operations

(c) Within each functional group, sets of numbers are reserved for particular subjects. The subjects used in the Intelligence Group, for example, are shown in the following table:

```
100-109:   Photo
110-119:   Immediate
120-129:   ELINT
130-139:   After Action
140-149:   Nuclear
150-159:   Biological
160-169:   Chemical
170-199:   Spare
```

2.3 <u>Message Names</u>. In addition to the message identifier, each message format is assigned a unique descriptive name and an abbreviated name that is commonly used. Both the names and the abbreviations are sometimes identical to message formats that are now in use. The contents of the JINTACCS versions are similar to but not identical to the older versions. For example, all of the message formats currently defined for the Intelligence Functional Group are listed in the following table:

A100	TARBUL	Target Bulletin
C100	IPIR	Initial Photo Interpretation Report
C101	SUPIR	Supplemental Photo Interpretation Report
C102	MIPIR	Multi-Mission Imagery Photo Interpretation Report
C110	INTREP	Intelligence Report
C111	TACREP	Tactical Report
C112	TGTINFOREP	Target Information Report
C113	HOTOPHOTOREP	Hot Photo Report
C120	MIJIFEEDER	Meaconing, Intrusion, Jamming Interference Feeder Report
C121	TACELINT	Tactical ELINT Report
C130	MISREP	Mission Report
C131	SENREP	Sensor Report
D100	JTACARSREQ	Joint Tactical Air Reconnaissance Surveillance Request
D110	RII	Request for Intelligence Information
D111	RRII	Response to Request For Intelligence Information
D120	JRSRR	Joint Remote Sensor Report/ Request
G130	DISUM	Daily Intelligence Summary
G131	INTSUM	Intelligence Summary

It will be noted that messages have not yet been defined for several of the subjects, such as chemical data. In several cases a JINTACCS message identifier has been associated with a well-known name and abbreviation (e.g., IPIR, MIPIR. SUPIR), but a JINTACCS format has not yet been approved. It is therefore to be expected that new formats will be added to the Intelligence Functional Group, and existing formats will be altered.

3.   MESSAGE STRUCTURE

    3.1 Format Definitions. A message format is defined as an
ordered collection of formatted groups called data sets. Each
data set starts with a unique keyword known as a set identifier.
The keyword is followed by one or more data fields, and any data
field may be individually identified by a keyword called either
a field descriptor or a header. The components of a data set
are separated by punctuation marks called delimiters. The
keywords and delimiters are provided to promote human
understanding of the message format as it is displayed on the
screen of a computer terminal. They will not be stored in
computer files or transmitted over communication lines with the
corresponding data words.

    The entries which may be made in each of the data fields are
described in the JINTACCS message specifications. Each data
field is assigned a unique name called the data field identifier
(DFI). Any data field may appear in two or more data sets, and
any data set may appear in two or more message formats. Data
fields contain values for either one specific data item or a
chain of linked data items. Fields may be of fixed or variable
length. The specification gives the length and the type of the
allowable values but not whether the length is fixed or
variable.

    3.2 Data Set Description. There are three types of data
sets, and any message format may be composed of any number of
data sets in any combination of types.

3.2.1 Linear data set. A linear data set is generally used when the information concerning one aspect of the message subject can be expressed sequentially in one 69-character Teletype line. The position, length and information content of each data field are given in the format specification. A field descriptor may be specified to precede or follow any data field to contribute to ease of use and understanding. The first entry in a linear data set is always the set identifier. This is a group of from three to eight alphabetic characters that suggests the type of information in the data set. The last entry is the end of set delimiter which is always a pair of slant symbols (//). Each data field is preceded by a field delimiter which is always a single slant symbol (/). If a field descriptor is used within a data field, it is separated from the data entry by a colon (:). The maximum number of data characters that may be inserted in the field is shown by the number of dots between delimiters. A typical linear data set would appear on the user's screen as follows:

PHOTODAT/PHOTIME:......./......./..../SCALE:....../PCTCOV:...//

3.2.2 Columnar data set. This type of data set is used to display information in columnar form under a single 69-character line composed of column headers. The position, length and information content of each data field are given in the format specification. A columnar data set always starts with a set identifier at the left margin of the first line. The set identifier consists of a numeric character followed by up to seven alphabetics. The second line consists of a field marker (/) at the left margin followed by the specified column headers separated by an appropriate number of blanks. The third line and any number of succeeding lines all consist of a field marker (/) at the left margin followed by data fields separated by an appropriate number of blanks. The data fields are to be filled in by the user with valid data entries or with hyphens (-) to indicate that no data is available. The final data line is always terminated by the end of set marker (//).

The correlation of data between two or more columnar data sets can be achieved by the use of data entry (DE) subfields. The header line will have DE as the first column header. All data lines that refer to the same entity or event will have the same two-digit numeric value inserted in the DE column. The values will start with 01 and may go as high as 99 within each message.

A typical columnar data set would appear on the user's screen as follows:

```
1BL
/DE TGTTYP SUBTYP QTY  SIZ  RAD     LGTH    WDTH    HEIGHT
/.. ...... ...... .... .... ....... ....... ....... .......
/.. ...... ...... .... .... ....... ....... ....... .......//
```

3.2.3 Free text data set. This type of data set is used to express unformatted narrative information of indefinite length. A set identifier and a field marker (/) are placed at the left margin of the first line, and an end of set marker (//) is placed after the last data word. The maximum length of the free text data is specified in each individual message format where the set is used. Three kinds of free text data sets are available and are differentiated by their set identifiers, as follows:

(a) Amplification. This data set is always preceded by the keyword AMPN and a field marker. It is used to insert an explanation or additional information concerning another data set. It must follow immediately after the set that it amplifies.

(b) Narrative. This data set is always preceded by the keyword NARR and a field marker. It is used to insert an explanation or additional information concerning two or more preceding data sets. The relationships between the data sets must be self-evident.

(c) Remarks. This data set is always preceded by the keyword RMKS and a field marker. It is used to insert an explanation or additional information concerning the entire message. If this set is used, it is the last data set in the message format.

3.3 Rules for Message Structuring.

3.3.1 Set occurrence. The message format consists of any number of set definitions. The order of the sets is fixed by the format specification, but all sets need not appear in a specific data message. Each set in the format is designated as mandatory (M), conditional (C), or optional (O). A mandatory set must be included every time the message format is used. An optional set will be omitted together with its set identifier when none of the data to complete the set is available. A conditional set will be used only under certain conditions that are described in individual message specifications. Any set may be used in two or more message formats. The structure of the set is always the same.

3.3.2 Set repetition. Any set may be designated as repeatable in an individual message format specification. Such a set may be repeated without limit at the discretion of the message writer. Repeatability is not an inherent characteristic of a set and may vary among the formats that contain the set.

3.3.3 Set continuation. A single message line will contain a maximum of 69 characters. Sets will usually occupy a single line but may be continued on consecutive lines. A field may not be divided between lines. The second and subsequent lines of a set must begin with a field marker at the left margin. Parts of two sets may not appear on a single line since the set identifier must always start at the left margin. An end of set marker may not be divided between two lines.

3.3.4 Groups of sets. A segment of a message is a group of sets that contains related information and that may be repeated as a group without limit at the discretion of the message writer. Repeated segments appear immediately after the original segment. A nested segment is a smaller grouping of sets within a larger segment. Nested segments may be repeated within the overall segment. Segmentation is not an inherent characteristic of any set and may vary among the formats that contain the set.

3.3.5 Field occurrence. The set consists of any number of field definitions. The order of the fields is fixed by the format specification. Each field in the set is designated as mandatory, conditional, or optional. The definitions for these terms are the same as for the set occurrence. Any field may be used in two or more set specifications. Each field has one unique Data Field Identifier that provides a general description of its data contents. A field may also have two or more Data Use Identifiers that describe the application of the field in a particular data set. The length and content of the values for two different Data Use Identifiers need not be the same.

3.3.6 Field repetition. The final field, or group of fields, in a linear data set may be specified to be repeatable. Repeatable fields are designated in the specification by an R.

3.3.7 Groups of fields. A group is a collection of associated fields that is assembled in one sequence and placed at the end of the set to allow its repetition. A group of fields is indivisible and is designated in the specifications by an R next to each field in the group.

3.3.8 Message parts. Message formats may be specified to be divided into separate parts by inclusion of a set with the set identifier PART.

3.3.9 Common sets. All message formats start with seven common sets and end with an eighth. The first set is always mandatory, and it contains the security classification. The last set contains downgrading instructions for classified messages. Incidentally, the classification set appears to be the only JINTACCS set that does not begin with a set identifier. The other common set identifiers are as follows: FLAGWORD, SIC, EXER, OPER, MSGID, AUTOPRO, and DWNGRADE.

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4. MESSAGE PROCESSING.

4.1 <u>Procedures</u>. A computer system that processes messages in JINTACCS format must store complete descriptions of all messages. These descriptions will assist the user in composing outgoing messages. They will also be used to check incoming messages prepared by other systems. Much of the data content of messages arriving at any MFT will be placed in data files automatically without the need for approval or modification by users. For this reason, proper preparation of messages is essential and must be guided by a computer program. Processing information is stored in the form of message formats, data set descriptions, data field descriptions, and field validation specifications.

4.2 <u>Message Formats</u>. Some of the 144 message formats that could be originated or received by components of the TACS are presented in Appendix C. The formats are given in alphabetic/numeric order according to message identifier. The table of contents also shows the abbreviated name and the descriptive name for each format. A format is described by giving skeleton descriptions of the data sets that comprise it. The keyword, any data field identifiers, all field delimiters, and the end of set delimiter are shown. The actual length of each field is not shown, but rather all fields are represented by single spaces. The maximum length of all the data fields in the data set is given followed by an M to indicate mandatory use of the data set, a C to indicate conditional use, or an O to indicate optional use. If a data set is repeatable, a R follows the M/C/O entry. If a data set is part of a repeating group, the number assigned to that group follows the other codes. In many cases, a name has been assigned to a data set to aid in understanding its purpose. The name appears in the right-hand column.

4.3 __Data Sets.__ Examination of the message formats will
show that many data sets are used in more than one format. In
particular, about 12 data sets appear in the headings of most
formats, and the data set that contains downgrading instructions
is used at the end of most formats. For efficiency and economy
of storage, it would be advisable to build a computer file of
the descriptions of all data sets used in all formats that might
be used by the computer. Appendix D shows the information that
should be stored for some of the data sets found in the TAF
message formats. The set identifier is followed by the numbers
assigned by JINTACCS to the data field identifiers and data use
identifiers that comprise the data set. The field descriptions
are to be stored in another file as described in the next
paragraph.

4.4 __Data Field Identifiers.__ Appendix D shows that many of
the data fields are used in two or more data sets, and therefore
field descriptions should be stored in a separate computer file.
Appendix E shows the information that should be stored for some
of the data fields found in the data sets of Appendix D. The
list is in two parts. Some fields are composed of other fields,
and these combined data fields are listed in the first part
together with their component fields. The second part shows the
descriptions of the individual data fields. The type of
characters, the maximum length in characters, and the type of
validation is given in addition to the field name that is
provided only to aid human understanding. The allowable values
for many of the data fields have been placed in tables by the
JINTACCS specification. The contents of some of these tables
are shown in Appendix E. Other fields may contain entries
specified as a range of values. For example, the number of a
month would fall in the range 1-12. Typical ranges are not
illustrated here but must be included in the application program
that check JINTACCS messages.

APPENDIX C
SAMPLE JINTACCS MESSAGE FORMATS

A100   TARBUL
Target Bulletin

Purpose: To provide a continuous update to the list of active
targets which may have to be taken under attack by supporting
arms to assist the supported unit and to report the analysis of
others on known targets.

DESCRIPTIVE ITEMS		DATA ITEMS		
/ / //	43	M		CLASSIFICATION
FLAGWORD/ / //	30	C		ROUTING INDICATORS
SIC //	3	C		SUBJECT IDENTIFIER
EXER/EXERCISE: //	55	C		EXERCISE NAME
OPER/ //	64	C		OPERATION NAME
MSGID/TARBUL/ / //	47	M		MSG IDENTIFICATION
AUTOPRO/A100/ / / / / / / //	32	C		AUTO. SYSTEMS INSTR.

HEADING/NEW TARGET//	-	C		
9AA DE	41	C	R	NEW TARGET DESCR.
TGT-LST-PRT				
MSG-REF-DTG				
TGT-ID				
TGTTYP				
SUBTYP //				
1AN DE	56	C	R	TERRAIN DESCRIPTION
TERRAIN-FEATURE-NAME				
LOCATION //				
HEADING/TARGET DAMAGED//	-	C		
9AB TGT-LST-PRT	28	C	R	TARGET STATUS
TGT-ID				
TGTSTATUS				
PCTDAM //				
HEADING/TARGET DESTROYED//	-	C		
9AC TGT-LST-PRT	16	C	R	TARGET DESCRIPTION
TGT-ID //				
HEADING/TARGET REACTIVATED//	-	C		
9AC TGT-LST-PRT	16	C	R	TARGET DESCRIPTION
TGT-ID //				
HEADING/TARGET CANCELLED//	-	C		
9AC TGT-LST-PRT	16	C	R	TARGET DESCRIPTION
TGT-ID //				

DWNGRADE/ //	25	C		DOWNGRADING INSTR.

A210   FMC
Fire Mission Command

Purpose: This message is used to check fire, to cease loading,
to cancel check fire, to cancel cease loading, and to provide
specified information to an observer.

```
/ / //                          43 M        CLASSIFICATION
SIC //                           3 -        SUBJECT IDENTIFIER
EXER/EXERCISE:  //              55 C        EXERCISE NAME
OPER/ //                        64 C        OPERATION NAME
MSGID/FMC/ / //                 47 M        MSG IDENTIFICATION
-----
CMD/ //                          6 C        FIRE SUPPORT COMMAND
EFDT/ / //                      10 O        EFFECTIVE DATE-TIME
FPN/ //                          6 O        FIRE PLAN DESIG.
TNO/ //                          6 O        F.S.  TARGET NBR.
GRID/ / / / //                  32 O        UTM GRID DESIG.
OBR/ //                          3 O        OBSERVER NUMBER
ROB/ //                          6 C        REPORT TO OBSERVER
-----
```

COMMENT:

A260   FSC
Fire Support Coordination Measures Report

Purpose: To propose, promulgate, and/or modify a fire support
coordination measure.

DESCRIPTIVE ITEMS	DATA ITEMS		
/ / //	43	M	CLASSIFICATION
SIC //	3	-	SUBJECT IDENTIFIER
EXER/EXERCISE: //	55	C	EXERCISE NAME
OPER/ //	64	C	OPERATION NAME
MSGID/FSC/ / //	47	M	MSG IDENTIFICATION

OPT/ / //	6	O	ACTION INDICATORS
EFDT/ / //	10	M	EFFECTIVE DATE-TIME
MEA/ //	6	M	FSC MEASURE
ATH/ //	10	M	AUTHORITY
APR/ //	3	O	APPROVED/PROPOSED
FPN/ //	6	O	FIRE PLAN DESIG.
PNT/ / / / //	34	C	POINT
CIR/ / / / //	36	C	CIRCLE
ACA/ / / / / / //	33	C	COVERAGE
ARES/ //	2	C	AUTHORIZE/RESTRICT
APR/ //	3	O	APPROVED/PROPOSED

DWNGRADE/ //	25	C	DOWNGRADING INSTR.

COMMENT:

A421   EXORD
Execution Order

Purpose: To implement an operations plan or order.

DESCRIPTIVE ITEMS	DATA ITEMS		
/ / //	43	M	CLASSIFICATION
SIC //	3	C	SUBJECT IDENTIFIER
EXER/ //	55	C	EXERCISE NAME
OPER/ / / / //	64	C	OPERATION NAME
MSGID/EXORD/ / //	47	M	MSG IDENTIFICATION

EXECUTE/ / / //	61	M	OPS PLAN DESCR.
AKNLDG/ //	1	M	ACKNOWLEDGEMENT

DWNGRADE/ //	25	C	DOWNGRADING INSTR.

COMMENT:

A422 FRAGORDER
Operation Fragmentary Order

Purpose: To provide an abbreviated operations order or a change
to an operations order for a limited portion of a given
operation.

DESCRIPTIVE ITEMS		DATA ITEMS
/ / //	43 M	CLASSIFICATION
SIC //	3 C	SUBJECT IDENTIFIER
EXER/ //	55 C	EXERCISE NAME
OPER/ / / / //	64 C	OPERATION NAME
MSGID/FRAGORDER/ / //	47 M	MSG IDENTIFICATION

PLANORD/OPLMNO: /OPERNO: /		
ANXNO: /APNDXNO: /TABNO: /		
ENCNO: /PAGENO: /		
PARANO: /LINENO: //	45 C	
FRAGORD/ / //	27 M	
NARR/ //	- C	FREE TEXT
HEADING/SITUATION//	C	
AMPN/ //	- C	FREE TEXT
HEADING/MISSION//	C	
AMPN/ //	- C	FREE TEXT
HEADING/EXECUTION//	C	
AMPN/ //	- C	FREE TEXT
HEADING/ADMIN AND LOG//	C	
AMPN/ //	- C	FREE TEXT
HEADING/COMMAND AND SIGNAL//	C	
AMPN/ //	- C	FREE TEXT
HEADING/TASKED ORGANIZATIONS//	C	
5UNIT UQ	91 C	
UNITID		
UNITLOC		
UNITLOC		
UNITLOC		
CMNTS //		
AMPN/ //	- C	FREE TEXT
HEADING/TASK ASSIGNMENTS//	C	
AMPN/ //	- C	FREE TEXT
HEADING/SPECIAL INSTRUCTIONS//	C	
AMPN/ //	- C	FREE TEXT
AKNLDG/ //	1 M	

DWNGRADE/ //	25 C	DOWNGRADING INSTR.

COMMENT:

A425   ERTM
ELINT Requirement Tasking Message

Purpose: For use by operational commanders to task resources
under their operational control for the purpose of ELINT
collection or to request ELINT collection from sources outside
their operational control.

DESCRIPTIVE ITEMS		DATA ITEMS	
/ / //	43	M	CLASSIFICATION
SIC //	3	C	SUBJECT IDENTIFIER
EXER/ //	55	C	EXERCISE NAME
OPER/ / / / //	64	C	OPERATION NAME
MSGID/ERTM/ / //	47	M	MSG IDENTIFICATION

AREAREQ/ / / //	51	M R	
5ELRQR DE	45	M R	
EMIT-DESIG			
L			
I			
P			
E			
REQACC			
ACPTACC			
ERR			
ERA			
TR			
TA			
DUR //			
5FRQRNG DE	24	C	
LOWFRQ			
UPFRQ //			
RMKS/ //	-	C	FREE TEXT

DWNGRADE/ //	25	C	DOWNGRADING INSTR.

COMMENT:

A440 WARNORD
Warning Order

Purpose: To inform subordinate units of contemplated action and
to initiate execution planning.

DESCRIPTIVE ITEMS		DATA ITEMS	
/ / //	43 M	CLASSIFICATION	
SIC //	3 C	SUBJECT IDENTIFIER	
EXER/ //	55 C	EXERCISE NAME	
OPER/ / / / //	64 C	OPERATION NAME	
MSGID/WARNORD/ / //	47 M	MSG IDENTIFICATION	

HEADING/SITUATION//	C		
AMPN/ //	- C	FREE TEXT	
HEADING/MISSION//	C		
AMPN/ //	- C	FREE TEXT	
HEADING/EXECUTION//	C		
AMPN/ //	- C	FREE TEXT	
HEADING/ADMIN AND LOG//	C		
AMPN/ //	- C	FREE TEXT	
HEADING/COMMAND AND SIGNAL//	C		
AMPN/ //	- C	FREE TEXT	
AKNLDG/ //	1 M		

DWNGRADE/ //	25 C	DOWNGRADING INSTR.	

COMMENT:

A635   HELOALDAT
Helicopter Airlift Mission Data Message

Purpose.   To provide mission details on a helicopter airlift
mission from the requesting agency to the complying agency.   To
be used by a component commander to task the forces from other
services that have been chopped to that commander.

DESCRIPTIVE ITEMS	DATA ITEMS	
/ / //	43 M	CLASSIFICATION
SIC //	3 C	SUBJECT IDENTIFIER
EXER/EXERCISE: //	55 C	EXERCISE NAME
OPER/ //	64 C	OPERATION NAME
MSGID/HELOALDAT/ / //	47 M	MSG IDENTIFICATION
AUTOPRO/A635/ / / / / / / //	32 C	AUTO. SYSTEMS INSTR.
CANX/ / / /AMD: //	49 C	REFERENCE MESSAGE

```
6HELODAT   MSNNO                   46 M R
           REQNO
           PRY
           HELMSN
           ACSIGN
           NOTPAC
           SIF  //
ALERT/ /ALRT:  /FROM:   /TO:   /
   ALRTLOC:   //              44 C R
REFNO/ //                      6 M R
6LOAD   DE                      60 C R
        ONLOC
        ONTIME
        QTY
        LDTYP
        OFFLOC
        OFFTIME
        QTY  //
TIMEAMP/ / / //                19 C R
7LOAD   DE                      41 C R
        CARGOWT
        CARGOSZ
        LGTH
        WDTH
        HEIGHT
        EX-IN
        H //
LANDPT/ /PTNM:   / //           41 C
LANDSTS/ /MRKING:   / /LSSTAT:  /
```

```
       CNTCS:  / / / MSNNO:  /
       DE:  //                         59 C
HEADING/MISSION CONTROL AND
         SUPPORT DATA//                - C
7CONTROL   REF                        60 C R
           C
           CALLSIGN
           PRIFRQ
           SECFRQ
           REPIN  //
SUPPORT/ / / //                       22 C
6RDZ   REF                            41 C R
       L
       RDZREF
       RENDCS
       PRIFRQ
       SECFRQ  //
7RDZ   REF                            26 C R
       ATIME
       RDZLOC
       DAL  //
ROUTEREF/ //                           6 C R
6ROUTE   DE                           59 C R
         ROUTEPT
         TYP
         ATIME
         DTIME
         SPD
         ALT
         ROUTE  //
AKNLDG/ //                             1 C
- - - - -
DWNGRADE/ //                          25 C      DOWNGRADING INSTR.
```

COMMENT:

A661   REQSTSTSK
Air Mission Request Status/Tasking Message

Purpose: To inform the requesting component whether a request
has been approved or disapproved and to inform the complying
command that it will satisfy the request. When authorized, this
message can be used between components.

DESCRIPTIVE ITEMS		DATA ITEMS	
/ / //	43	M	CLASSIFICATION
SIC //	3	C	SUBJECT IDENTIFIER
EXER/EXERCISE: //	55	C	EXERCISE NAME
OPER/ //	64	C	OPERATION NAME
MSGID/REQSTSTSK/ / //	47	M	MSG IDENTIFICATION
AUTOPRO/A661/ / / / / / / //	32	C	AUTO. SYSTEMS INSTR.
CANX/ / / /AMD: //	49	C	REFERENCE MESSAGE

REF/ / / / / / //	60	M R	
HEADING/REQUEST STATUS//	-	C	
6APPDIS REQNO	41	M R	
REQCMD			
REQSTS			
COMCMD			
RPRY //			
HEADING/CROSS FORCE TASKING//	-	C	
6REQUEST REQNO	47	M	
PRY			
AMSN			
TOT			
TFT			
NOTPAC			
MSNLOC //			
TIMEAMP/ / / //	19	C R	
MSNLCAMP/ /MSNLCTYP: / //	41	C R	
TANKDAT/ /ARSYS: /FUREQ: /			
FUEL: //	16	C R	
RECDAT/ /RECTYP: /TYPCOV: /			
TYPSEN: /PHOTO: /FILM: /			
STEREO: //	28	C R	
ESCDAT/ /ORDTYP: / //	32	C R	
HELOLIFT/ /ONLOC: /OFFLOC: /			
NOPAX: /PAXTYPE: /			
TOTALWT: / //	86	C R	
6EW REF	33	C R	
EWTYP			
GENTYP			

```
     EMIT
     ELNOT //
AKNLDG/ //                        1 C
-----
DWNGRADE/ //                     25 C          DOWNGRADING INSTR.

COMMENT:
```

A690   TACOPDAT
Tactical Operational Data Message

Purpose: To permit the joint operational commander to establish
air defense and anti-air warfare responsibilities in a tactical
area. To permit an area commander to provide supplementary
orders for his area of responsibility.

DESCRIPTIVE ITEMS   DATA ITEMS

/ / //   43 M   CLASSIFICATION
SIC //   3 C   SUBJECT IDENTIFIER
EXER/EXERCISE: //   55 C   EXERCISE NAME
OPER/ //   64 C   OPERATION NAME
MSGID/TACOPDAT/ / //   47 M   MSG IDENTIFICATION
AUTOPRO/A690/ / / / / / / // 32 C   AUTO. SYSTEMS INSTR.
CANX/ / / /AMD: //   49 C   REFERENCE MESSAGE

REF/ / / / / / //   60 C R
EFFECTIV/ / /SUP: //   16 M
AAW/ / / //   50 C R
GND/ / / / //   44 C R
CAP/ /ALT: / / / / //   79 C R
AEW/ /MINALT: / / / //   49 C R
AUTOCAT/ /MINALT: /TX: /
    REC: / //   56 C R
AAR/ /ALT: / / / //   50 C R
DUTIES/ / //   23 C R
SURVEIL/ / /SECLIMIT: /
    SECLIMIT: / //   61 C R
DEFENSE/ / /SECLIMIT:
    SECLIMIT: / //   61 C R
HANDO/ / //   40 C R
MEX/ /RAD: / //   47 C R
SAFERAD/ /RAD: /CTRBRG: /
    WDTH: /LOALT. /UPALT: // 34 C R
SAFECOR/ /WDTH: /LOALT: /
    UPALT: / //   48 C
6VOICNET   VOICENET   22 C
        PRIFRQ
        SECFRQ: //
6CRYPTO   NETREF   132 C
        CDDAY
        FROM
        TO
        ENCRYPT
        ENCRDEV //

```
EMP/EMCOM:  /FROM:  /TO:  //          15 C  R
6ZZ/ZZPOS: /TIMPOS: /CRS: /
    SPD: /AAWAX: /ANGLE: //           30 C
CTRLPT/ / / / //                      49 C  R
MARSH/ / /CALLSIGN: / //              56 C  R
SPDIS/ / / //                         28 C  R
AKNLDG/ //                             1 C
-----
DWNGRADE/ //                          25 C       DOWNGRADING  INSTR.
```

COMMENT:

A770   ALORD
Alert Launch Order

Purpose: To launch alert aircraft that have been tasked for
cross-force missions.

DESCRIPTIVE ITEMS   DATA ITEMS

/ / //   43 M   CLASSIFICATION
SIC //   3 C   SUBJECT IDENTIFIER
EXER/EXERCISE: /;   55 C   EXERCISE NAME
OPER/ //   64 C   OPERATION NAME
MSGID/ALORD/ / //   47 M   MSG IDENTIFICATION
AUTOPRO/A770/ / / / / / / //   32 C   AUTO. SYSTEMS INSTR.

LAUNCH/MSNNO: /LNCHTIM: /
     INITCON: / /FNLCON: / / //   83 M R
HEADING/OTHER MISSION DATA//   - O
6TARGET   REF   49 C
          TG
          TGTLOC
          RESDES
          TGTTYP
          SUBTYP
          QTY   //
REFMAP/ / / / //   32 C R
TGTDAT/TGTID: /TGTLOC: /TRAD: /
     TLGTH: /TWDTH: /ALIGNMT: /
     DOP: /TIMPOS: /HDG: / / //   85 C R
GNDFRND/ /MRKING: / /
     TIMPOS. / //   39 C R
BCNREF/ / //   26 C R
6SHIP   DE   26 C R
        REF
        SID
        QTY
        SHPTYP
        HULL
        TG   //
7SHIP   DE   50 C R
        TIMPOS
        SHIPLOC
        CRS
        SPD   //
6REFUEL   REF   58 C R
          TANKERCS
          ANCHOR

```
           RFLTIME
           ALT
           ONFU
           FUEL
           ARSYS   //
7REFUEL    REF                    38 C R
           PRIRFL
           SECRFL
           PRIOFF
           SECOFF //
ALT/REF: / / //                   18 C R
AKNLDG/ //                         1 C
-----
DWNGRADE/ //                      25 C         DOWNGRADING INSTR.
```

COMMENT:

A900   ADSCRAMORD
Air Defense Scramble Order

Purpose: Used by the TACC and CRC to provide Air Defense
scramble instructions to the WOC.

DESCRIPTIVE ITEMS		DATA ITEMS	
/ / //	43	M	CLASSIFICATION
FLAGWORD/ / //	30	C	ROUTING INDICATORS
EXER/EXERCISE: //	55	C	EXERCISE NAME
OPER/ / / / //	64	C	OPERATION NAME
MSGID/ADSCRAMORD/ / //	47	M	MSG IDENTIFICATION
AUTOPRO/A900/ / / / / / / //	32	C	AUTO. SYSTEMS INSTR.

SEGMENT/SCRAMBLE//	-	M	
FLTSZTYP/ //	8	M	
VCTCLALT/ / / //	12	M	
CSTACFRQ/ / //	28	M	
RMKS/ //	-	O	FREE TEXT

DWNGRADE/ //	25	C	DOWNGRADING INSTR.

COMMENT:

APPENDIX D
JINTACCS DATA SET SUMMARY

SET IDENT	DFI/DUI	OCCUR	MANDATORY ENTRY
ADD		C	(NO DATA FIELD IDENTIFIERS)
AFTER		C	(NO DATA FIELD IDENTIFIERS)
AID	E564-15	C	
	E564-8	M	
	E564-9	O	
	E564-9	M	
	E564-11	O	
	E564-12	M	
	E487-47	O	
	E564-5	O	
	E982-1	O	
	E564-7	O	
	C315-3	O	
AIRDROP	E987-4	M	DELADDR
	C011-9	M	DROPLOC
	C012-17	C	DROPLOC
	C683-4	C	DROPLOC
	E493-2	C	RUNHDG
	E002-1	M	CALLSIGN
	E651-2	M	PRIFRQ
	E681-2	C	PRIFRQ
	E651-3	M	SECFRQ
	E681-3	C	SECFRQ
AIRWHAT	E031-1	C	
	E034-1	C	
	E141-1	C	
	C142-7	M	
	E032-4	C	
	E071-1	C	
AKNLDG	E319-3	M	
ALT	E673-1	C	REF
	E1028-1	M R	
	E491-1	M R	
AMPN			(A FREE TEXT SET)
APPOR	E987-18	M	
	E922-1	M	
	E107-4	M R	
	E027-16	M R	
	E031-17	M R	
ARDAT	E673-1	M	
	E491-2	M	ALT
	E651-20	M	PRIRFL

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SET IDENT	DFI/DUI	OCCUR	MANDATORY ENTRY
	E681-20	C	PRIRFL
	E651-21	M	SECRFL
	E681-21	C	SECRFL
	E651-22	M	PRIOFF
	E681-22	C	PRIOFF
	E651-23	M	SECOFF
	E681-23	C	SECOFF
	E538-2	M	FUEL
	E539-1	M	ARSYS
	E907-4	C	UNCMTFU
AUTOPRO	E339-1	M	(ACTUAL MESSAGE ID)
	C051-20	M	
	E517-2	C	
	E328-1	C	
	E319-1	C	
	E333-1	C	
	C327-1	C	
	E242-1	C	
BCNREF	E500-1	M	
	E673-1	M R	
CANCEL		C	(NO DATA FIELD IDENTIFIERS)
CANX	E050-1	M	
	E146-1	M	
	C147-1	M	
	E345-1	C	AMD
(CLASIF)	E148-2	M	(CLASSIFICATION)
	E331-1	C R	
	E149-1	C R	
COLLINFO	E314-1	C	
	E337-1	C	
	E001-2	C	
	E336-1	C	
COMMAND	E987-18	M	
CONTROL	E007-1	M	CONT
	E002-1	M	
	E651-2	M	
	E681-2	C	
	E651-3	M	
	E681-3	C	
	C469-7	C	
	C497-6	C	
	C498-7	C	
	E500-22	C	
	C542-8	C	
DELETE		C	(NO DATA FIELD IDENTIFIERS)

SET IDENT	DFI/DUI	OCCUR	MANDATORY ENTRY
DES	E150-5	M	DES
DFC	E150-7	M	DFC
DWNGRADE	E679-1	M	
EMP	E689-1	M	EMCOM
	C143-6	M	FROM
	C143-7	C	TO
EMTRWHAT	E031-1	C	
	E109-1	C	
	E141-1	C	
	C142-7	M	
ENLOS	E031-7	C	ACTKIA
	E031-8	C	ESTKIA
	E031-9	C	ESTWIA
	E031-10	C	CPTRD
ESCDAT	E673-1	C	
	E495-2	M	ORDTYP
	C496-2	M R	
	C619-2	C R	
EXER	E335-1	M	EXERCISE
FACDAT	E673-1	C	
	E651-2	M	
	E581-2	C	
	E651-3	M	
	E681-3	C	
FLAGWORD	E334-1	M	
	E479-1	C	
GNDFRND	E673-1	C	
	E212-1	M	MRKING
	E467-1	C	
	C143-19	M	TIMPOS
	C011-6	M R	
	C012-16	C R	
	C498-9	C R	
GNDWHAT	E031-1	C	
	E066-1	C	
	E141-1	C	
	C142-7	M	
	E032-4	C	
	E071-1	C	
HEADING	E326-2	M	(SPECIFIED BY MSG. FORMAT)
HELOLIFT	E673-1	C	
	C011-17	M	ONLOC
	C012-25	C	ONLOC
	E500-33	C	ONNAM
	C011-18	M	OFFLOC

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SET IDENT	DFI/DUI	OCCUR	MANDATORY ENTRY
	C012-26	C	OFFLOC
	E500-34	C	OFFNAM
	E031-53	C	NOPAX
	E476-1	C	PAXTYPE
	C453-4	C	TOTALWT
	C619-1	C R	
IDC	C011-8	C	
	E150-11	C	MPR
IMR	C075-9	M	
	E584-3	M	
	E944-1	M	
	E564-3	C	
	E564-4	M	
	E564-5	M	
	E982-1	M	
	E564-7	O	
	E487-46	O	URG
IPIR	E517-2	M	
	E487-48	M	SER
	E584-3	M	PRJ
	E944-1	M	MSN
	C033-2	C	DTZ
	C981-2	C	
ISR	E499-2	M	ISR
	C064-1	M	
	E491-7	M	PENALT
ITEMID	E487-43	M	ITM
	C010-1	M	
	C943-1		
	E119-1	M	CAT
	E057-3	M	
MARWHAT	E031-1	C	
	E198-1	C	
	E141-1	C	
	C142-7	M	
	E032-4	C	
	E071-1	C	
MIPIR	E517-2	M	
	E487-48	M	SER
	E584-3	M	PRJ
	E944-1	M	MSN
	C033-2	C	DTZ
	C981-2	C	DTZ
MSGID	E050-1	M	
	E146-1	C	

SET IDENT	DFI/DUI	OCCUR		MANDATORY ENTRY
	C147-1	C		
MSGREF	E050-1	M		
	E146-1	M		
	C147-1	M		
	C051-20	M		DRAFTDAT
	E345-1	C		AMD
MSNID	E001-1	M		MSNNO
	E003-1	C		REQNO
	E004-1	C		FRAG
	E005-1	C		OPORD
	E002-1	O		
MSNLCAMP	E500-16	M		
	E629-1	M		MSNLCTYP
	C011-2	M	R	
	C012-12	C	R	
	C329-3	C	R	
	C498-4	C	R	
	C683-2	C	R	
NARR				(A FREE TEXT SET)
NOTES	E673-1	C		
	E673-3	M	R	
OBEQ	E031-19	M		
	E564-14	M		
	E066-1	M		
	E151-1	O		
	E150-10	O		
OBID	E985-1	M		
	C075-7	O		
	E150-9	C		
	E942-1	M		
	E584-3	M		
	E944-1	M		
	E564-3	C		
	C075-6	M		
OPER	E336-1	M		
OTID	E487-44	C		REQ
	E059-1	M		CTY
	C011-1	M		
	C012-23	O		UTM
	C542-10	O		UTM
	E986-1	O		MRG
PERCOV	C143-6	M		FROM
	C143-7	M		TO
PERID	C143-6	M		
	C143-7	M		

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SET IDENT	DFI/DUI	OCCUR	MANDATORY ENTRY
PERIOD	C051-4	M	ENDING
PHOTODAT	C143-10	M	PHOTIME
	E122-1	O	
	E087-1	O	
	E086-1	O	SCALE
	E027-4	O	PCTCOV
PPC	E150-8	M	PPC
PRM	C110-2	C	
	E320-1	C	
	E088-1	C	PRI
	E325-1	C	
	E093-1	C	PD
	E092-1	C	
	E091-1	C	
	E089-1	C	
PROTFREQ	C652-1	M R	
	E908-3	M R	
RECCE	E046-1	M	EEICAT
	E047-1	M	PHOTCONF
RECDAT	E673-1	C	
	E107-8	M	RECTYP
	E122-1	M	TYPCOV
	E121-1	C	TYPSEN
	E104-1	C	PHOTO
	E112-1	C	FILM
	E102-1	C	STEREO
REF	E050-1	M	
	E046-1	M	
	C143-1	M	
	E580-1	M	
	C147-1	O	
	E332-1	O	
REFMAP	E673-1	C	
	E117-1	M	
	E116-1	O	
	E487-36	O	
REPORT	E987-4	M	DELADDR
	C143-25	M	LTIOV
	E031-11	M	DPRIOROK
	E031-1	C	QTY
	E111-1	C	RECPROD
	E911-1	C	SCL
	E050-2	C R	
REQDATA	E003-1	M	
	E106-1	C	PREC

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SET IDENT	DFI/DUI	OCCUR	MANDATORY ENTRY
	E105-1	M	PRY
	C075-3	M	DATEDES
	C315-3	C	TOT
	C051-2	M	LTIOV
	E031-11	C	DPRIOROK
	E107-8	M	
	E122-1	M	
	E121-1	C	
	E104-1	C	PHOTO
	E112-1	C	FILM
	E102-1	M	STEREO
	C113-1	M	
REQDATC	C095-4	M	
	C006-12	C	
	C124-13	C	RUNINHDG
REQDATD	E001-1	C	MSNNO
	E002-1	C	
	E034-1	C	
	C315-5	C	TOFF
	C315-4	C	ETOT
	E002-3	C	INITCONT
	C110-2	C	RFREQ
	C006-15	C	ORBITPT
	E002-2	C	FINCONT
	C110-2	C R	RFREQ
REQDATF	C051-3	M	DATDES:
	E105-1	C	PRY
	C051-2	C	LTIOV
REQUEST	E003-2	M	REQNO
	E936-1	M	PRY
	E937-1	C	PRY
	E938-1	C	PRY
	E107-4	M	AMSN
	C084-2	M	TOT
	C143-47	C	TOT
	E617-2	C	TOT
	C084-3	C	TFT
	C143-48	C	TFT
	C496-1	C	NOTPAC
	C011-2	M R	
	C012-12	C R	
	C498-4	C R	
	E500-16	C R	
	C554-2	C R	
	C555-2	C R	

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SET IDENT	DFI/DUI	OCCUR	MANDATORY ENTRY
	C556-2	C R	
	C683-2	C R	
RFP	E108-1/	M	
	E475-1		
	C143-6	C	FROM
	C143-7	C	TO
	C062-1	C	WDTH
	C036-2	C	ALTMX
	C036-3	C	ALTMN
	C006-13	C	LOCFM
	C006-14	C R	LOCTO
RMK	E150-6	M	RMK
RMKS			(A FREE TEXT SET)
ROUTEREF	E673-1	M R	
SIC	E332-1	M R	
SOI	C143-4	M	
	C315-2	M	
	E118-1	M	
	E109-1	M	
	C340-1	M	
	C341-1	M	
	C012-1	M	
	C061-5	M	
	C062-3	M	
	E999-2	M	TB
	E126-1	M	NR
	E059-1	M	
	E316-1	M	
	C016-1	O	
SOURCE	E053-1	C	
	C143-8	M	
	C054-1	C	
STATACT	E983-2	M	STA
	E983-3	O	
	E584-2	M	
	E942-1	O	SGN
	E584-3	O	PRJ
	E944-1	C	MSN
	E564-3	C	
	C075-8	C	IMDATE
	E984-1	C	NRG
SUPIR	E517-2	M	
	E487-48	M	SER
	E584-3	M	PRJ
	E944-1	M	MSN

SET IDENT	DFI/DUI	OCCUR	MANDATORY ENTRY
	C033-2	C	DTZ
	C981-2	C	DTZ
SUPPORT	E673-1	C	
	E107-4	M R	
	E001-1	M R	
	E003-2	C R	
SUPREQ	E019-1	C	TGTTYP
	C006-6	C	TGTLOC
	C143-11	C	DESDT
TANKDAT	E673-1	C	
	E539-1	M	ARSYS
	E907-5	M	FUREQ
	E538-2	M	FUEL
TASKUNIT	E987-21	M	
	E150-1	C	
TGTCOD	C183-1	M R	
TGTDAT	E500-27	C	TGTID
	C554-3	C	TGTID
	C555-3	C	TGTID
	C556-3	C	TGTID
	C011-8	C	TGTLOC
	C012-2	C	TGTLOC
	C498-6	C	TGTLOC
	C683-7	C	TGTLOC
	C060-4	C	TRAD
	C061-4	C	TLGTH
	C062-4	C	TWDTH
	C124-7	C	ALIGNMT
	E099-1	C	DOP
	C143-19	C	TIMPOS
	E067-2	C	HDG
	C064-1	C	
	C199-1	C R	
TGTPRI	E107-4	M	AMSN
	E019-1	M R	
	C183-1	M R	
	E908-2	M R	
	E939-1	M R	
TIMEAMP	E673-1	C	
	E682-1	M R	
	C084-1	M R	
	C143-1	C R	
	E617-1	C R	
TRPLN	C006-49	M	
	C006-50	C R	

SET IDENT	DFI/DUI	OCCUR	MANDATORY ENTRY
TSKDAT	E003-1	C	REQNO
	E004-1	C	FRAG
	E005-1	C	OPORD
TYP	E050-2	M	
	C113-1	C	MAPREF
UNIT	C095-1	M	
	E002-1	C	
WHERE	C329-4	C	
	C330-1	C	
	E057-1	C	
	C124-14	C	
	C061-5	C	
	C062-3	C	
	C124-15	C	
	C064-3	C	
	C036-1	C	
	C305-1	C	
WHO	E059-1	C	
	C095-2	C	
	C016-1	C	
ZZREF	E987-37	M	
1AJ	E082-1	M	DE
	E119-1	M	FUNCT
	C016-1	C	TGT-ID
	E019-1	C	TGTTYP
	E020-1	C	SUBTYP
	E031-1	C	QTY
	E046-1	C	EEICAT
1AK	E082-1	M	DE
	E057-1	C	TERRAIN-FEATURE-NAME
	C006-6	M	TARGET-LOCATION
	E128-1	M	LQFR
1AL	E082-1	M	DE
	C123-1	C	STR-ID
	E121-1	C	TYP-SEN
	C196-1	C	SEN-CHAN
	C006-7	C	STR-LOC
	C075-5	C	IMPLDAT
	E031-12	C	BATLIF
1AM	E082-1	M	DE
	E048-1	C	RCVRY
	E204-1	C	CALL-CHAN
	C075-6	C	REMDAT
	E633-1	C	RLY-REQD
1AN	E082-1	M	DE

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APPENDIX E
DATA FIELD IDENTIFIER SUMMARY

PART 1 - COMBINED DATA FIELD IDENTIFIERS

CDFI	EDFI	VAL	NAME
C006		16an	LOCATION
	E176-1		
	C011-1/		
	C012-1		
C010		10an	BASIC ENCYCLOPEDIA NUMBER
	E153-1		
	E154-1		
	E155-1		
C011		15an	GEOGRAPHIC COORDINATES
	E017-1		
	E156-2		
	E157-2		
	E158-2		
	E018-1		
	E156-3		
	E157-3		
	E158-3		
C012		13an	LOCATION, UTM 10 METER GRID
	C159-1		
	C160-1		
	C161-1		
C016		13anv	TARGET IDENTIFIER
	E013-1		
	E008-1/		
	E009-1/		
	C010-1/		
	C317-1/		
	E304-1/		
	E487-25		
C033		7an	DATE-TIME ZONE
	C075-1		
	E026-1		
C036		8an	ALTITUDE
	E177-1		
	E031-1		
	E029-4		
C038		8an	CLOSEST MISS CHARACTERISTICS
	E192-4		
	E040-1		
	E041-1		

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CDFI	EDFI	VAL	NAME
C051		11an	DATE AND TIME
	E021-1		
	E022-1		
	E023-1		
	E024-1		
	E026-1		
C054		2an	EVALUATION OF INFORMATION
	E056-1		
	E055-1		
C058		40an	PLACE OF BIRTH
	E057-4		
	E059-1		
C060		7an	RADIUS
	E031-1		
	E029-4		
C061		8an	LENGTH
	E031-1		
	E029-4		
	E306-1		
C062		8an	WIDTH
	E031-1		
	E029-4		
	E306-1		
C063		8an	HEIGHT
	E031-1		
	E029-4		
C064		8an	SPEED OF MOVEMENT
	E031-1		
	E306-1		
	E029-8		
C068		9a	TARGET STATUS
	E069-1		
	E070-1		
	E071-1		
C073		3an	MILITARY PAY GRADE
	E168-1		
	E169-1		
C075		6an	DATE
	E021-1		
	E022-1		
	E023-1		
C076		32an	EQUIPMENT
	E15101		
	E213-2		
	E066-1		

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CDFI	EDFI	VAL	NAME
	E213-2		
	E152-1		
C084		6an	RELATIVE TIME, HRS AND MINS
	E201-1		
	E209-1		
	E024-1		
	E025-1		
C090		7an	MEASURED SIGNAL STRENGTH
	E031-1		
	E029-7		
C095		24an	UNIT DESIGNATOR
	E096-1		
	E097-1		
	E098-1		
C110		11an	RADIO FREQUENCY
	E253-1		
	E029-6		
C113		26an	MAP REFERENCE
	E117-1		
	E116-1		
	E115-1		
	E021-1		
	E022-1		
C123		6an	SENSOR STRING iD AND STATUS
	E170-2		
	E170-3		
	E487-11		
	E173-1		
C124		8an	AXIS DAY-TIME
	E023-1		
	E024-1		
	E025-1		
	E026-1		
C144		7an	ELEVATION
	E031-1		
	E029-4		
C147		7n	MESSAGE SERIAL NUMBER
	E022-1		
	E023-1		
	E487-13		
C159		3an	UTM GRID ZONE DESIGNATION
	E162-1		
	E163-1		
C160		2an	UTM 100KM SQUARE ID
	E164-1		

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APPENDIX E
DATA FIELD IDENTIFIER SUMMARY

PART 2 - INDIVIDUAL DATA ELEMENTS

EDFI	VAL1	VAL2	NAME
E001	6anbf		MISSION NUMBER
E002	17anbv		CALL SIGN
E003	6anbv		AIR TASK REQUEST NUMBER
E004	4nf		FRAG ORDER NUMBER
E005	7anbv		OP ORDER NUMBER
E007	1at	T007	TYPE OF CONTROL AGENCY
E008	6asnf		TARGET IDENTIFIER
E009	9anf		THEATER TARGET NUMBER
E013	1at	T013	TARGET SYSTEM IDENTIFICATION
E017	2nfr	R1	LATITUDE (00-90)
E018	3nfr	R2	LONGITUDE (000-180)
E019	6avt	T019	TARGET TYPE
E020	6avt	T020	TARGET SUBTYPE
E021	2nf		YEAR
E022	2nfr	R3	MONTH (01-12)
E023	2nfr	R4	DAY (01-31)
E024	2nfr	R5	HOUR (00-24)
E025	2nfr	R6	MINUTE (01-60)
E026	1ar	R7	TIME ZONE (NO J)
E027	3nv		PERCENTAGE
E029	3avt	T029	UNIT OF MEASUREMENT
E030	6anfp	P030	CALIBER, MM
E031	4anvx	N031	QUANTITY
E032	8anvt	T032	ORDNANCE TYPE
E034	20anl	N034	AIRCRAFT NAME
E035	7anl		TYPE SURFACE TO AIR FIRE
E037	3avt	T037	RELATIVE INTENSITY OF FIRE
E040	2nfr	R3	CLOCKWISE DIRECTION (01-12)
E041	1at	T041	RELATIVE VERTICAL POSITION
E042	1at	T042	EVASIVE ACTION
E043	11ast	T043	AIRCRAFT LOSS, CAUSE
E044	4at	T044	DOWNED ACFT CREW STATUS
E045	10at	T045	WEATHER TYPE
E046	2nf		EEI CATEGORY
E048	2at	T048	SENSOR RECOVERY STATUS
E050	20anvt	T050	MESSAGE TITLE
E052	4at	T052	TARGET UNIT SIZE
E053	12ant	T053	TYPE INTELLIGENCE SOURCE
E055	1nr	R9	EVALUATION OF ACCURACY
E056	1ar	R10	EVALUATION OF RELIABILITY (A-F)

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EDFI	VAL1	VAL2	NAME
E057	381		TERRAIN FEATURE NAME
E059	2anl	N059	COUNTRY
E065	6at	T065	TYPE OF HUMAN SOURCE
E066	18anv		EQUIPMENT NAME
E067	3at	T067	DIRECTION/HEADING
E069	3aft	T069	OCCUPANCY STATUS
E070	3aft	T070	OPERATIONAL STATUS
E072	27al		NAME, INDIVIDUAL
E074	10anl		PERSONAL ID NBR
E077	3avt	T077	INDICATION OF NBC TRAINING
E078	8avt	T078	PROTECTIVE CLOTHING TYPE
E079	5at	T079	VEGETATION AREA TYPE
E080	40anl		ADDRESS, RESIDENTIAL
E081	20anl		OCCUPATION
E082	2nf		DATA ENTRY NUMBER
E087	4af	T087	QUALITY OF IMAGERY
E096	4anl		UNIT NUMBER
E097	13avt	T097	ORGANIZATION TYPE
E098	7avt	T098	ECHELON
E099	6avt	T099	DEGREE OF PROTECTION
E100	12avt	T100	TYPE OF BARRIER/OBSTACLE
E105	1nfr	R12	MISSION PRIORITY (1-4)
E107	5avt	T107	MISSION TYPE
E108	5anvt	T108	RESTRICTIVE FIRE PLAN
E109	5an	N001	EMITTER DESIGNATION
E111	5avt	T111	RECCE PRODUCT DESIRED
E114	2at	T114	RADIO/RADAR FUNCTION
E115	2nf		EDITION SERIAL NUMBER
E116	14anl		CARTO. ITEM DESIGNATION
E117	6anl		SERIES DESIGNATOR
E118	5n	N001	ELINT NOTATION
E119	5nvl	N119	FUNCTIONAL CLASSIFICATION
E120	6avt	T120	USE OF BARRIER/OBSTACLE
E121	2aft	T121	TYPE OF SENSOR
E122	7avt	T122	TYPE OF RECCE COVERAGE
E125	8avt	T125	ECM TYPE
E126	5anl		TARGET SIGNAL NUMBER
E128	3at	T128	LOCATION QUALIFIER
E130	12avt	T130	ECM ACTION
E131	12avt	T131	ECM EFFECT
E132	3avt	T132	TARGET LIST PART
E135	20anl		OPERATOR POSITION, EQUIPMENT AFFECTED
E137	6al		SHIP TYPE
E138	5avt	T138	TYPE BIO/CHEM AGENT
E139	10ant	T139	TYPE ELECTRONIC INTERFERENCE

EDFI	VAL1	VAL2	NAME
E140	18anl		GROUND EQUIPMENT NAME
E141	6avt	T141	ACTIVITY TYPE
E146	20anl		MESSAGE ORIGINATOR
E148	33avt	T148	SECURITY CLASSIFICATION
E149	2a	N149	CONTROL AND RELEASE MARKING
E150	anl	N150	COMMENTS
E151	6avt	T151	EQUIPMENT CATEGORY
E152	6anl		EQUIPMENT MODEL
E153	4nl		WORLD AREA NUMBER
E154	lant	T154	PROGRAM INDICATOR
E155	5nf		INSTALLTION ID SN
E156	2nfr	R13	MINUTE OF ANGLE (00-59)
E157	2nfr	R13	SECOND OF ANGLE (00-59)
E158	laft	T158	TERRESTRIAL HEMISPHERE
E162	2nfr	R6	UTM GRID ZONE COLUMN (01-60)
E163	lafr	R14	UTM GRID ZONE ROW (C-H:J-N:P-Z)
E164	la		UTM 100KM SQ COLUMN
E165	la		UTM 100KM SQ ROW
E166	4nf		UTM 10M EASTING
E167	·4nf		UTM 10M NORTHING
E168	lat	T168	MIL PERSONNEL CLASS
E169	2nfr	R15	PAY LEVEL (01-11)
E170	lat	T170	ARMED SERVICE
E173	lat	T173	SENSOR STRING STATUS
E176	3aft	T176	COORDINATE CONVENTION
E177	laft	T177	DATUM PLANE
E178	2nvrR16	RECCE	TARGET CATEGORY (1-14)
E179	6at	T179	FRIENDLY FIRE SUPPORT EFFECT
E182	laf	EEI	RECCE TARGET CATEGORY (A-Z)
E192	20anl		NAME/NUMBER OF SHIP
E201	2avt	T201	REFERENCE INDICATOR
E202	2nf		SENSOR IDENTIFICATION
E204	9nf		CALL CHANNEL
E205	4nf		SENSOR CHANNEL
E209	lst	T209	ARITHMETIC SYMBOL
E212	6avt	T212	FRIENDLY POSITION MARKINGS
E213	lsbt	T213	DATA DELIMITER
E242	env		BLOCK COUNT
E253	8anvr	R18	RADIO FREQUENCY
E258	4avt	T258	ROUTE POINT TYPE
E300	2anr	R19	DECISECOND OF ANGLE (.0-.9)
E304	121		HULL TO EMITTER CORR NBR
E306	4an	N001	DECIMAL QUANTITY
E312	2nfr	R13	SECOND OF TIME (00-59)
E314	2af	N001	COLLECTOR DIGRAPH

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APPENDIX E
DATA USE IDENTIFIER SUMMARY

PART 3 - VALIDATION TABLES

ID	I,N	TABLE NAME/TABLE ITEMS				
T007	(1, 5)	TYPE OF CONTROL AGENCY				
		F	I	M	O	R
T013	(1, 6)	TARGET SYSTEM IDENTIFICATION				
		A	B	H	P	T	X
T019	(6,68)	TARGET TYPE				
		ABOAT	AIRFLD	ARM	ASSY	AUXLRY	BASE
		BLDG	BRIDGE	CMDCTR	COMBIN	COMELT	COMLN
		DAM	DROPZN	DTACP	ECMAIR	ECMSUR	ESMAIR
		ESMDLT	ESMSUR	FERRY	GOVINS	HQ	INDCMX
		LANDG	LDGZON	MBOAT	NAVAID	NAVTE	NAVTG
		NAVTU	NVTF	PARMIL	PCIVIL	PLSCFT	PMIL
		POLSTA	PONT	PORT	PTLCFT	PWRIN	RAFT
		RAILRD	ROWBT	SAIL	SAMPN	STORAR	SUPDMP
		TFORD	TFORT	TMMADE	TNATUR	TOWER	VARMOR
		VARTY	VBOAT	VCSPT	VENGNR	VOTHER	VPLANE
		WADA	WARTY	WGUN	WINDIV	WMORT	WOTHER
		WRKT	WSPEC				
T020	(6, 356)	TARGET SUBTYPE				
		ACFTPR	ADAHVY	ADALT	ADAMED	ADAMSL	ADAUNK
		ADFHQ	AFBASE	AIRFLD	ALOGHQ	ARBASE	ATPARM
		ATPMEC	ATPVEH	ATRP	ATSHQ	AUNK	BEACON
		BLDCON	BLDMET	BLDMSN	BLDSP	BLDUNK	BLDWD
		BMGFLD	BRGAVL	BRGFFB	BRGFFP	BRGFFR	BRGFLT
		BRRFRY	BRGFTC	BRGFTS	BRGFTW	BRGFXD	BRGMA
		BRGPNL	BRGRDY	BRGRR	BRGUNK	BRGVC	BRGVFB
		BRGVFP	BRGVL	BRGVS	BRGVW	BUOY	CANTEN
		CBATRY	CEW	CFL	CGENTR	CHEMPR	CINFRA
		CLASER	CLIGHT	CLSPKR	CMBAT	CMDIV	CMDLG
		CMDMED	CMDSM	CMFWD	CMICRO	CMNI	CMRGT
		CODATA	COMPTR	COPTIC	COTHER	CPHOTO	CRADAR
		CRADIO	CRADOM	CRDAIR	CRDATA	CRDGND	CRDODF
		CRDODG	CRDOTE	CRDRAB	CRDRCM	CRDRDF	CRDRED
		CRT	CSORNG	CSRCHL	CSWBD	CTDATA	CTELE
		CTELEG	CTELEP	CTELEV	CTROPO	CTTY	CUNK
		CWIRE	DAMRIP	DASSYA	DBLOCK	DCBTOP	DCHECK
		DCNTRM	DELECT	DESURV	DFARRP	DHEADP	DLELEM
		DLINK	DMERTH	DMONCR	DMSNRY	DMSTON	DOPLP
		DPASAG	DPCNTR	DRELES	DSTART	DSTRING	DTACIC
		DTACOC	DZEQP	DZSUP	DZTRP	FLKTWR	FLOTHQ
		FLTHQ	FRDCNC	FRDIMP	FRDNAT	FRDSTN	FTRFLD

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ID	I,N	TABLE NAME/TABLE ITEMS				
		GFHQ	HELFLD	HITECH	HZDLIT	ILSLCL	JCMDHQ
		LITBCN	LORAN	LRAVHQ	LTHOUS	LZFXWG	LZHELO
		MAPORT	MARBAS	MIPORT	MKRBCN	MSLPR	MUNPR
		MVPR	NAVABS	NAVBAS	NAVNHQ	NNVLHQ	NVAVHQ
		OBSTRC	OBSTWR	OPSTWR	PAGENT	PARMIL	PARTSN
		PATROL	PDFCTR	PDSRTR	PEM	PETRPR	PFO
		PGENOF	PGUER	PGUNER	PHOSTG	PILOT	PINF
		PINTEL	PIPE	PMEDIC	PMINLR	PMP	PMSGR
		PNCO	POBSVR	POFF	POP	POW	PRFLMN
		PSABOT	PSAPER	PSCOUT	PSNIPR	PSTBHD	PUNK
		PWKPTY	PWRESL	PWRHYD	PWRLN	PWRNUC	PWRSST
		PWRTHM	RADTWR	RAIL	RCNFLD	ROAD	RRCLAS
		RREQRP	RRFTRM	RRLDPM	RRPTRM	RRRLY	RRSTOR
		RRTRLD	SAMHQ	SHIPYD	SHORAN	SMIL2D	SMIL2R
		SMILL1	SMILL2	SMILL4	SMLEAF	SMNGAS	SMPGAS
		SSMHQ	STRI	STRII	STRIII	STRIV	STRV
		STRVII	SUPI	SUPII	SUPIII	SUPIV	SUPUNK
		SUPV	SUPVII	SYPORT	TACAN	TAVNHQ	TBLDGP
		TBLDGT	TBLDGV	TBUNKR	TCAVE	TCHURC	TCMTRY
		TDEPRS	TEMPLC	TFHOLE	THELIP	THLTOP	THOSP
		TLAKE	TLANDS	TMARSH	TPILBX	TPOLST	TPRISN
		TRAIL	TRDJCT	TRENCH	TREVET	TRIDGE	TRLJCT
		TRLSTP	TROAD	TRR	TRRCRS	TRRJCT	TRVCRS
		TSADLE	TSCHOL	TSTREM	TUNNEL	TVALEY	TVTWR
		UNK	UNKWN	VAHVY	VALT	VAMBL	VAMED
		VAMPHB	VAN	VAPC	VARMOR	VARMUK	VARSPT
		VARTY	VBIKE	VBMBR	VBUS	VCART	VCAS
		VCE	VCMPSR	VCRANE	VDITCH	VDOZER	VDRONE
		VDUMPT	VENGNR	VFBMBR	VFIRET	VFORKL	VFTR
		VGLIDR	VGRADR	VHAMB	VHASLT	VHATK	VHCARG
		VHELO	VHFTRK	VHLFT	VHOBS	VHWHEL	VIP
		VLSPT	VLVTP	VLWHEL	VMETB	VMLCHR	VMOTOC
		VMWHEL	VOTHER	VPILED	VPLANE	VRECCE	VRECON
		VRLCHR	VROCK	VRPV	VRTANK	VSHOVL	VSPAAA
		VSPATY	VSPLOW	VSTOL	VTANK	VTETRN	VTNKR
		VTOL	VTRAIN	VTRANS	VTRCTR	VTRLR	VTRNSP
		VTRUCK	VTWAAA	VTWATY	VUNK	VUTIL	VWRECK
		WTRTWR	WWY				
T029	(3, 65)	UNIT OF MEASUREMENT					
		ACR	BBL	CCM	CM	CPS	CUF
		CUI	CUM	CUY	DAY	DBM	DBW
		DEG	DGG	DGM	DGT	FT	GAL
		GHZ	HAM	HR	HZ	IN	J
		KHZ	KM	KPH	KT	KTS	KW
		LB	LTN	M	MHZ	MIL	MIN

ID   I,N   TABLE NAME/TABLE ITEMS

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              MLG       MLM       MLT       MM        MPH       MS
              MSE       MT        MTT       MW        NM        NSE
              PAL       PPS       RAD       SCM       SEC       SKM
              SM        SMM       SMT       SPC       SQF       SQI
              SQM       SQY       TON       W         YD
T032 (6, 13)  ORDNANCE TYPE 1000GP  2000GP  250GP     500GP     CBU
                 FFAR
              GDBMB     GRNADE    GUNS      ILLUM     NAP       RKT
              SNAKE
T037 (3, 4)   RELATIVE INTENSITY OF FIRE
              HVY       LT        MED       UK
T041 (1, 3)   RELATIVE VERTICAL POSITION
              H         L         X
T042 (1, 2)   EVASIVE ACTION
              N         Y
T043 (11, 21) AIRCRAFT LOSS, CAUSE
              AD-ARTY           AD-SAM            AIRBOMBS
              AIR-STRFNG        CLSN-OBSTL        CRASH
              FIELD-ARTY        GND-ACDNT         GUN-AA
              INTAC-URCVR       MIDAIR            MSLS-AG
              MSLS-RKT-AA       MSLS-RKT-SS       NAV-GUNFIRE
              NUC-ACT           SABOT-EXT         SABOT-INT
              SMALL-ARMS        UNK               WEATHER
T044 (4, 7)   DOWNED ACFT CREW STATUS
              AKIA      CHUT      CPTD      CPTI      RESC      SAFE
              UNK
T045 (10, 71) WEATHER TYPE
              BLOW-DRIZ         BLOW-DUST         BLOW-SAND
              BLOW-SNOW         CLEAR             COLD FRONT
              CYCLONE           DRFTGSNOW         DRIZZLE
              DRZLLSTHR         DRZLRAIN          DUST
              DUSTSTORM         FOG               FOGLSTHR
              FREEZ-DRIZ        FREEZE-RAIN       FUNNEL-CLD
              GROUNDFOG         HAIL              HAILSHWR
              HAZE              HEAVY-RAIN        HEAVY-SNOW
              HIGH-WINDS        HURRICANE         HVYDRZLRN
              HVYFZDRZL         HVYFZRAIN         HVYRNSHWR
              HVYRNSNO          HVYSNSHWR         HVYTSTM HVYTSTMH
                   ICEPELLETS        ICEPLSTHR
              ICING             LIGHTNING         LIGHTRAIN
              LIGHTSNOW         MIST              OCLD-FRONT
              RAIN              RAINLSTHR         RAINSHWR
              RAINSNOW          RNSNOSHWR         SANDSTORM
              SHALLOWFOG        SNOW              SNOWLSTHR
              SNOWSHWR          SQUALLS           SQUALLINE
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ID   I,N   TABLE NAME/TABLE ITEMS

STAT-FRONT	TORNADO	TROFLINF
TROPDEPRN	TROP-STORM	TSTM
TSTMHAIL	TSTMLSTHR	TURB
TYPHOON	WARM FRONT	WATERSPOUT

T048 (2, 2)   SENSOR RECOVERY STATUS
                NR   R
T050 (20, 124) MESSAGE TITLE

ABFACSTS	AIRDEFALRT
AIRDEFCMDMSG	AIRMSNREQ
AKNLOG	ALORD
ALRTACSAMSTS	AMMO REPT
APORTM	CALLFORFIRE
CASMSNASMT	CFMSNDATA
CHECKFIRE	COMMSPOT
CONF	DESIGAREA
DESIGHOUR	DISUM
ECMDATA	EMPLOYALOC
ENGSTS	ERTM
EWATM	EWERM
EXORD	FIREMSNSUM
FIREPLNGMSG	FLTCONTINFO
FLTPLN	FRAGORD
FSCMEASREP	FUSTATREPT
FUTURE1	FUTURE2
FUTURE3	FUTURE4
FUTURE5	FUTURE6
HELO-TALREQ	HELOAVIL
HELODLY	HELOMSNDATA
HELORQST	HELOSKED
HOTPHOTOREP	IMPREP
INFLT	INITHAND
INTREP	INTSUM
IPIR	JAMDECMSG
JATO	JCASINTREQ
JESCREQ	JRECREQ
JRSRR	JTACARSREQ
JTFSTAT	LANDLNDGFORC
LNCHDEV	LOGSIT
METB	METCM
METREQUEST	MIJIFEEDER
MIPIR	MISREP
MONCHGREP	MONTERMREP
MSGCHANGEREP	MSGTOOBSR
MSNSUM	NBC1BC
NBC1N	NBC2BC

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